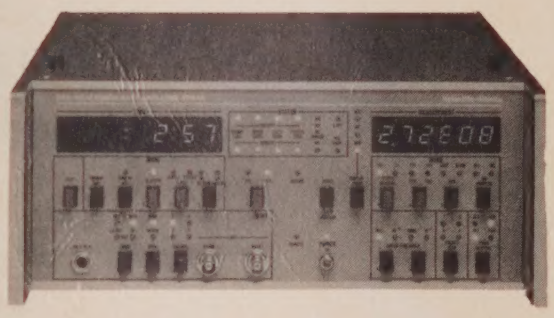
MAINTENANCE MANUAL

Viking Labs / Honeywell
370 BERNARDO AVENUE
MOUNTAIN VIEW, CALIFORNIA 94043

Model 4654A
Error Rate Analyzer



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Scientific Atlanta

Model 4654A
Error Rate Analyzer

Maintenance Manual

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INSTRUMENTATION

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OVERVIEW

0.1 INTRODUCTION

The Scientific-Atlanta Model 4654A DS1/1C/2 Error Rate Analyzer is supplied with two manuals: the Operator's and the Maintenance. This Maintenance manual provides technical information such as theory of operation, service maintenance procedures, parts listings, printed circuit board layouts and schematics, and is designed to be used in conjunction with the Operator's manual. However, some of the more frequently referred to information (from the Operator's manual) is reprinted in this Overview section in case the Operator's manual is not readily available.

NOTE:

The information in this manual is intended for use by an experienced technician only.

Although this unit is very similar to the Model 4654 Test Set Receiver, there are several differences. Please be sure you have the correct manual for your unit.

0.2 TECHNICAL SPECIFICATIONS

DATA INPUT	
Rates	Accepts standard DS1/1C/2 rates
Impedance	Balanced, 110Ω
Input Connector	Accepts a WE 310 plug
Return Loss	Greater than 30 dB for a 20 ns rise time pulse for signal voltage between ±0.2 and ±3.0 volts
Sensitivity	AGC operates over full range of transmitter outputs. LO/DSX and HI selectable for DS2 inputs

NRZ INPUTS Clock Data	 75Ω, dc coupled, TTL level 75Ω, dc coupled, TTL level
DATA FORMATS	Switch selectable for PRBS or non-PRBS data inputs. Recognizes all transmitter data formats including programmed sequence to perform bit error measurements.
CHANNEL SELECT	Selects any or all DS1 channels from DS1C or DS2 data stream for error measurement.
SYNCHRONIZATION[1] Mode: Frame In-Sync Frame Out-of-Sync DS1 Framing	 PRBS automatic at error rates up to 10^{-2} in less than two hundred clock cycles F-Frame: 8 successive F bits match M-Frame: 3 M bits match in an M-Frame 3 F-bit errors between M4 bits 3 successive M-Frames have M-bit errors Synchronizes in less than 5 ms.
CLOCK EXTRACTION:	PLL with an equivalent Q of 110 ± 20
MEASUREMENT MODES[2] ERROR-SECONDS TOTAL ERRORS AVERAGE (AVG) BER BER BURST ERRORS	 Counts and displays number of seconds when BER exceeds selected threshold during a TIMED or ELAPSED time test. Error-seconds can also be indicated as a percent (%) of total seconds. Internal jumper selects synchronous or asynchronous measurement technique. Count and display total number of errors since beginning of TIMED or ELAPSED test for errored seconds above selected threshold. Calculates and displays error rate based on total number of errors (in error-seconds above selected threshold) divided by the total number of bits since beginning of the TIMED or ELAPSED time test. Count and display error rate averaged over short or long interval (fast or slow update) Consecutive errored milliseconds for selected error type (Bit or BPV)

DC Monitor (Optional)	Two DC VOLTAGE inputs and two DRY CONTACT inputs can be monitored. The first display position in the MEASUREMENT DISPLAY contains the status of the selected DRY CONTACT input (blank = Inactive, A = Active, and H = has been active during the timed test). The remainder of the display shows DC Voltage for the selected input.
STATUS INDICATORS GATING	ON, indicates a measurement in process. Blinks when display updates.
POWER LOSS	Flashes after power failure. On continuously after manually RESET.
ALL ONES	ON, indicates all ones data in selected DS1 Channel.
X-BIT	OFF, indicates X-bit is a 1 ON, indicates X-bit is a 0
The following four conditions have two indicators each to show the previous status (to indicate the condition has existed since the last manual RESET) and current operating status. Minimum ON time for present indicators is 100 milliseconds.	
(1) Signal Loss	ON, indicates signal loss or signal below operating level.
(2) Frame Loss	ON, indicates a frame loss (see synchronization).
(3) Data Loss	ON, indicates a loss of synchronization of internally generated data pattern which is determined by 16 or more errors in 128 clock cycles.
(4) Excess Zero	ON, indicates an excess string of zeros, 16 or more for DS1, 34 or more for DS1C, and six or more for DS2.
IN 1 and IN 2 DC Threshold	On when DC VOLTAGE for respective input exceeds programmed upper threshold or is less than programmed lower threshold. LED flashes at the end of a test if that input went out of threshold during the test.

REAL-TIME CLOCK and TIMER Time Display	Seven-digit numeric display shows time of day, month/day, elapsed time, time remaining in test, or DC voltage thresholds as indicated by the associated mode indicators. Timekeeping is accomplished by means of a real-time clock circuit backed up by a Ni-Cad battery to permit timekeeping in the absence of external power, and recovery upon re-application of power. With DC MONITOR Option installed, voltage thresholds from -40.00 to 40.00 may be entered in the TIME display.
Clock Power	NI-CAD rechargeable battery. Recharged when receiver power on; three months operation without recharging.
Untimed Mode	Count and display error rate with FAST or SLOW update.
Timed Modes	Timer can be set to count down from a preset time, TIMED mode; or set to ELAPSED to count up. While timer is running, all error types are counted simultaneously for ERROR-SECONDS (TOTAL and %), TOTAL ERRORS and AVG. BER. BURST errors (TOTAL or LENGTH of last burst) are counted for selected error type.
MEASUREMENT DISPLAY	Select error type or dc voltage to be displayed. All error types are simultaneously counted and switches select type to be displayed.
Bit Errors	Bit errors are detected by comparing an internal data bit sequence or pattern with a similar received sequence. Bit errors can be measured on PRBS and non-PRBS patterns.
Bipolar Violations	DS1/1C, violation of alternate mark inversion coding. DS2, violation of B6ZS coding.
DC Monitor Option	Leftmost display position is status of selected DRY CONTACT input (blank = Inactive, A = Active, H = has been active during the test). The rest of the display is DC voltage from -40.00 to 40.00. Input 1 data is displayed only if DC MONITOR IN 1 is selected and input 2 data is displayed only if DC MONITOR IN 2 is selected.
Error Threshold	Switch selectable thresholds between 10^{-6}, PROG, 10^{-3} or all errors during one-second interval.

MEASUREMENT RANGE Error Rates	1.00×10^{-2} to 1.0×10^{-50}
Counts (error-seconds and total errors)	0 to 999,999 in decimal notation then 1.00×10^{6} to 9.99×10^{50} in scientific notation.
DC Voltage	-40.00V to 40.00V
SYNC OUTPUTS[3]	Rear panel BNC's for CLOCK, FRAME, PRBS-SYNC, ERROR, and DATA.[3]
REMOTE CONTROL	Unit can operate via IEEE-488 bus or RS-232C
GENERAL Power Supply	110/220V ac, 50-60 Hz -22V to -60V dc, positive ground 60 watts
Non-Volatile RAM and Real-Time Clock	Non-volatile RAM for operating mode and measurement storage, Real-Time clock using internal NI-CAD battery.
Temperature	Operating: 0° to 50°C Storage: -20° to 50°C
Dimensions	13"W x 15"D x 5.25"H
Weight	25 lbs

NOTE: [1] The T-1 Serial Receiver IC indicates loss of carrier if it receives 31 consecutive zeros. Frame sync search begins on the next 1. Therefore, the analyzer will not operate with "all zeros" data when DS1 is framed.

[2] If XMTR sends DS1C/DS2 unframed, the analyzer will synchronize on bit pattern and measure bit errors.

[3] FRAME output produces a pulse at every framing bit location in DS1. In DS1C or DS2, it produces a pulse at the M1 bit in each M-Frame.

MODEL 4650 PRINTER (OPTIONAL)

Interface Format	Parallel input, eight-bit-parallel/character serial, standard ASCII format, 21 characters/line.
Modes	ALL or Partial printout modes selectable on the 4654A (displays Error Burst Data in ALL mode). Conditions which trigger printout selectable on the 4654A front panel. Printout may be triggered by (a) Bit Error Rate greater than selected threshold, (b) a DC Voltage input going out of threshold, or (c) either of these conditions. Logs on Error-Second until 40 continuous Error-Seconds are encountered. (This log mode is suppressed for Single or Repeat Timed tests of less than 1 hour duration.) Logs on PRINT command from front panel of the 4654A. Logs at end of test.
Power	Derived from the 4654A through interface cable.

0.3 FRONT AND REAR PANEL CONFIGURATION

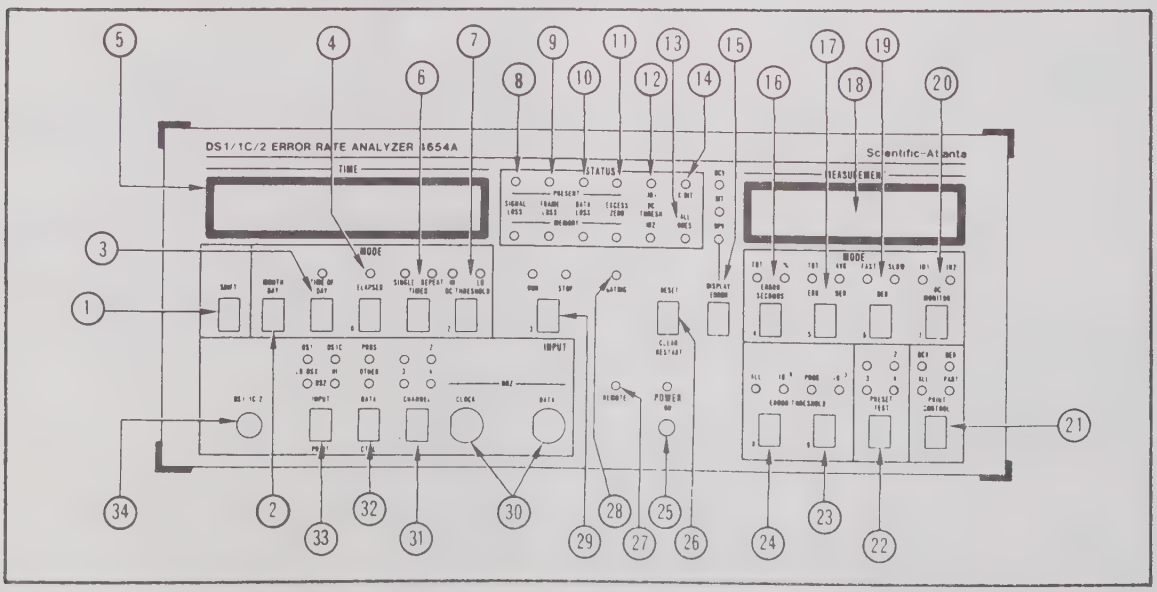


Figure 0.1. Front Panel Controls and Indicators

Reference Symbol	Panel Decal
1	SHIFT Switch
2	MONTH-DAY Switch
3	(MODE) TIME OF DAY Switch and Indicator
4	(MODE) ELAPSED Switch and Indicator
5	TIME Display
6	(MODE) TIMED SINGLE-REPEAT Switch and Indicator
7	HI-LO DC THRESHOLD Switch
8	(STATUS) SIGNAL LOSS Present and Memory
9	(STATUS) FRAME LOSS Present and Memory
10	(STATUS) DATA LOSS Present and Memory
11	(STATUS) EXCESS ZERO Present and Memory
12	IN 1 - IN 2 DC THRESHOLD (Status)
13	(STATUS) ALL ONES
14	(STATUS) X-BIT
15	DISPLAY ERROR Switch
16	(MODE) ERROR-SECONDS TOT and % Switch and Indicators
17	(MODE) TOT ERR and AVG BER Switch and Indicators
18	MEASUREMENT Display
19	(MODE) BER-FAST and SLOW Switch and Indicators
20	(MODE) IN 1 - IN 2 DC MONITOR
21	(PRINT) DCV or BER ALL or PART Switch and Indicators
22	PRESET TEST Switch and Indicators
23, 24	ERROR THRESHOLD Switch and Indicators
25	POWER Switch and Indicator
26	RESET/CLEAR Switch
27	REMOTE Indicator
28	GATING
29	RUN/STOP Switch and Indicators
30	NRZ-INPUT DATA and CLOCK Connectors
31	CHANNEL Select Switch and Indicators
32	(INPUT) DATA-PRBS or OTHER Switch and Indicators
33	INPUT-DS1, DS1C, DS2-LO/DSX, or DS2-HI Switch and Indicators
34	(INPUT) DS1/1C/2 Connector

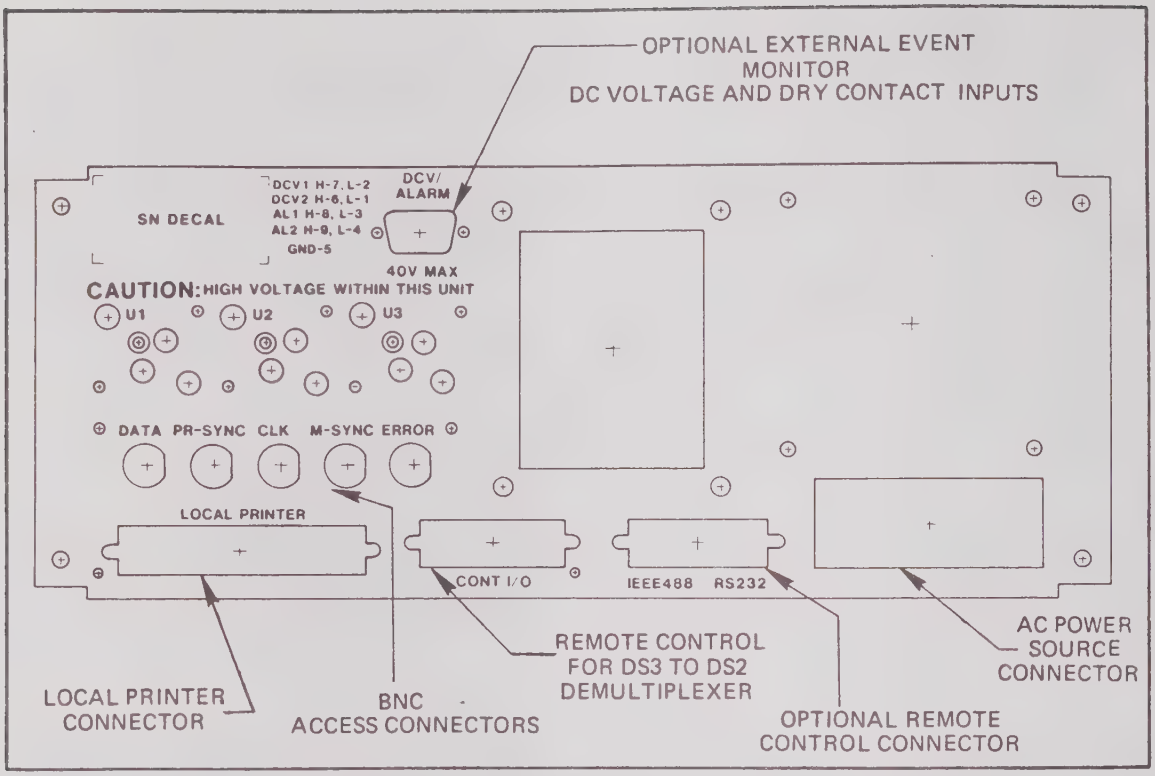


Figure 0.2 Rear Panel Features

CHAPTER 4
THEORY OF OPERATION

4.1 GENERAL

Theory of operation for the Model 4654A DS1/1C/2 Error Rate Analyzer is presented in two parts. Part One describes the power supply while Part Two describes features and functions. The power supply is described in a separate section because the dc supply used in this system operates independently from other circuits. The receiver may be ordered with an ac/dc switching supply or an ac-only linear supply. Both are described in this section.

A discussion for the microcomputer program is also included, but no program listing is provided.

The Model 4654A Analyzer receives DS1, DS1C, or DS2 formatted digital signals in either a bipolar arrangement or a non-return to zero (NRZ) arrangement with separate clock and data lines. Figure 4.1 outlines key features of the DS1 signal format, Figure 4.2 outlines key features of the DS1C signal format, and Figure 4.3 outlines key features of DS2 signal format. The Model 4654A Analyzer accepts a DS1, DS1C, or DS2 signal, and synchronizes on the received data pattern and detect bit errors and bipolar violations in the received data.

The Model 4654A also provides an option of two dc voltage inputs for measuring the AGC voltage, and two "dry contact" inputs for monitoring the status of alarms. Thresholds for the dc inputs are programmable such that any excursions above or below the selected threshold points will actuate a front panel indicator and trigger a printout on the Model 4650 printer.

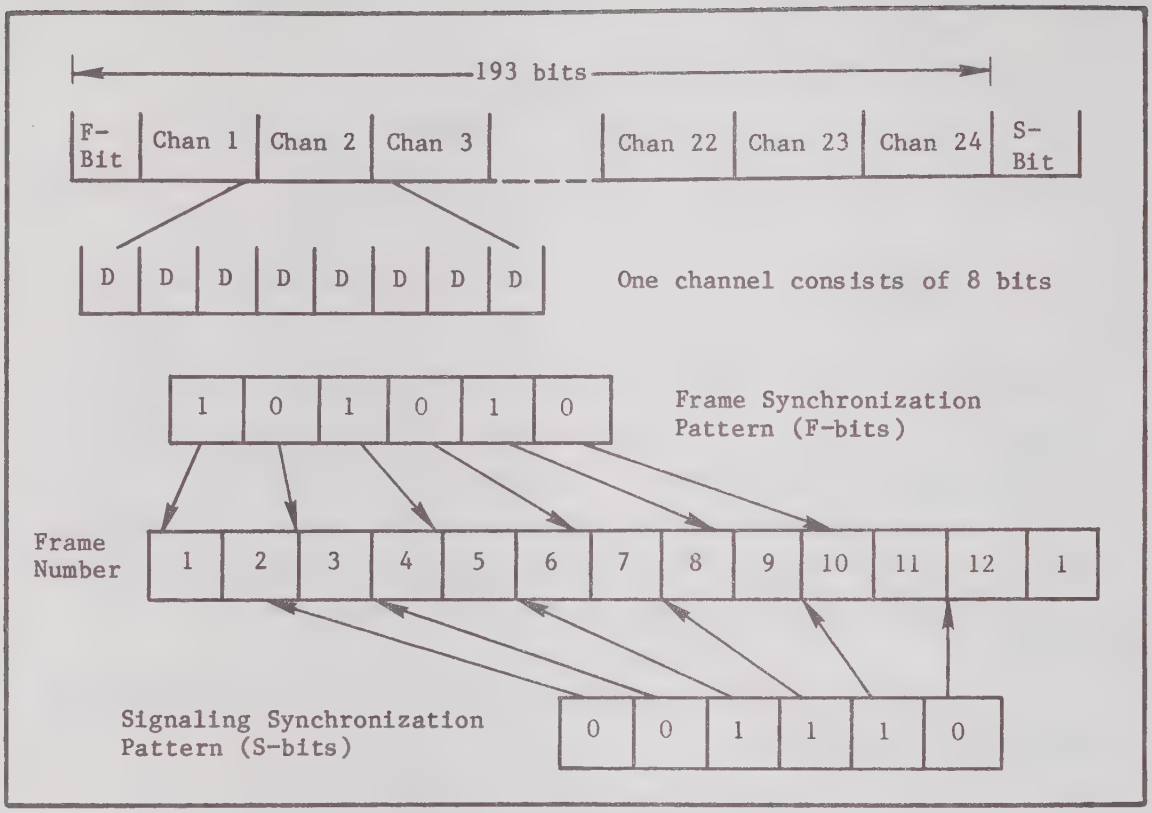
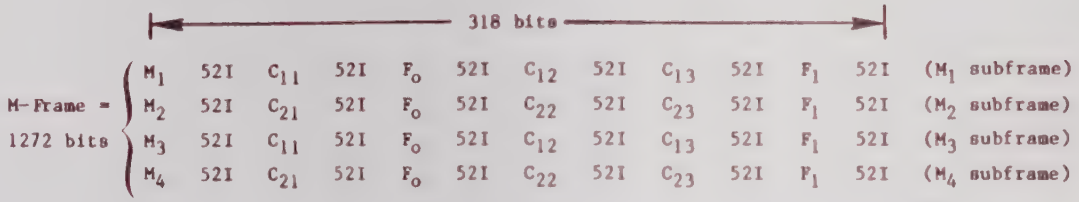


Figure 4.1. DS1 Format

4.2 MODEL 4654A DC SUPPLIES

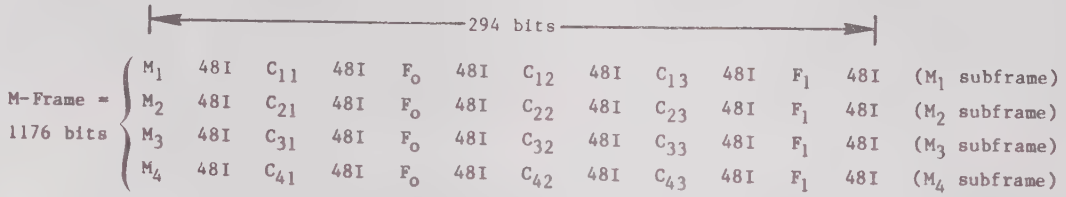
Source power for the Model 4654A Analyzer may be supplied from a 115V/220V, 50/60 Hz ac line and/or from a -22V to -60V dc, positive ground, Station Battery connection. Either source can provide the internal dc voltage required to operate the Pulse Width Modulator power supply circuits. The Pulse Width Modulator provides a switching-type power source that has high efficiency, low weight, and versatile operating voltages. If both ac and dc sources are connected to their respective inputs, the ac is transformer reduced and rectified to approximately -40 volts dc. The two dc sources are "diode-ORed" to allow the highest source potential to drive the power supply circuits.


318 bits
M-Frame = 1272 bits
M1 52I C11 52I Fo 52I C12 52I C13 52I F1 52I (M1 subframe)
M2 52I C21 52I Fo 52I C22 52I C23 52I F1 52I (M2 subframe)
M3 52I C11 52I Fo 52I C12 52I C13 52I F1 52I (M3 subframe)
M4 52I C21 52I Fo 52I C22 52I C23 52I F1 52I (M4 subframe)

LEGEND:
1. An M-Frame consists of four subframes defined by the Mn bit. M_1 = 0, M_2 = 1, M_3 = 1, M_4 = 0 or 1 (X-bit)
2. The F_0 bits are always "0's".
3. The F_1 bits are always "1's".
4. The C bits are all "0" unless a stuff is to occur in a particular subframe, in which case they are all changed to "1's" in that subframe. Channel 1 stuffs occur in the M_1 or M_3 subframes, and Channel 2 stuffs occur in the M_2 or M_4 subframes. Channel "n" stuffs in the third channel "n" data bit after the Cn3 bit.
5. 52I; Location of 52 information bits, 26 for Channel 1 alternating with 26 for Channel 2.

Operational Notes:
1. The Analyzer declares F-bits are "In-Frame" when 8 successive F-bits agree with the predicted pattern, and declares "Out-of-Frame" when 3 or more F-bit errors occur in an M-Frame.
2. The Analyzer declares M-bits are "In-Frame" when the sequence "011" is found, and declares "Out-of-Frame" when 3 successive M-Frames have M-bit errors.

Figure 4.2. DS1C Format


294 bits
M-Frame = 1176 bits
M1 48I C11 48I Fo 48I C12 48I C13 48I F1 48I (M1 subframe)
M2 48I C21 48I Fo 48I C22 48I C23 48I F1 48I (M2 subframe)
M3 48I C31 48I Fo 48I C32 48I C33 48I F1 48I (M3 subframe)
M4 48I C41 48I Fo 48I C42 48I C43 48I F1 48I (M4 subframe)

LEGEND:
1. An M-Frame consists of four subframes defined by the Mn bit. $M_1 = 0$, $M_2 = 1$, $M_3 = 1$, $M_4 = 0$ or 1 (X-bit)
2. The F_0 bits are always "0's".
3. The F_1 bits are always "1's".
4. The C bits are all "0" unless a stuff is to occur in a particular subframe, in which case they are all changed to "1s" in that subframe. Channel "n" stuffs occur in the Mn subframes at the first channel "n" data bit after the F_1 bit. Where n = 1, 2, 3, or 4.
5. 48I; Location of 48 information bits, 12 from each of the 4 channels.

Operational Notes:

1. The Analyzer declares F-bits are "In-Frame" when 8 successive F-bits agree with the predicted pattern, and declares "Out-of-Frame" when 3 or more F-bit errors occur in an M-Frame.
2. The Analyzer declares M-bits are "In-Frame" when the sequence "011" is found, and declares "Out-of-Frame" when 3 successive M-Frames have M-bit errors.

Figure 4.3. DS2 Format

A. AC/DC INPUT POWER SOURCES

Figure 4.4 is a block diagram of input power source distribution for the Model 4654A Analyzer. The rear panel schematic is shown in Figure 7.39. Both sides of the ac power source (hot and neutral) are "switch interrupted" while the third wire safety ground is connected directly to the chassis. The applied ac is reduced through transformer T1 to approximately 42 volts ac RMS which is then rectified by diode bridge CR3 on the Rectifier and Filter Assembly PCB. The output voltage from CR3 is a nominal -55V dc. It is filtered by capacitors C4 and C5 and applied to one terminal of diode bridge CR2.

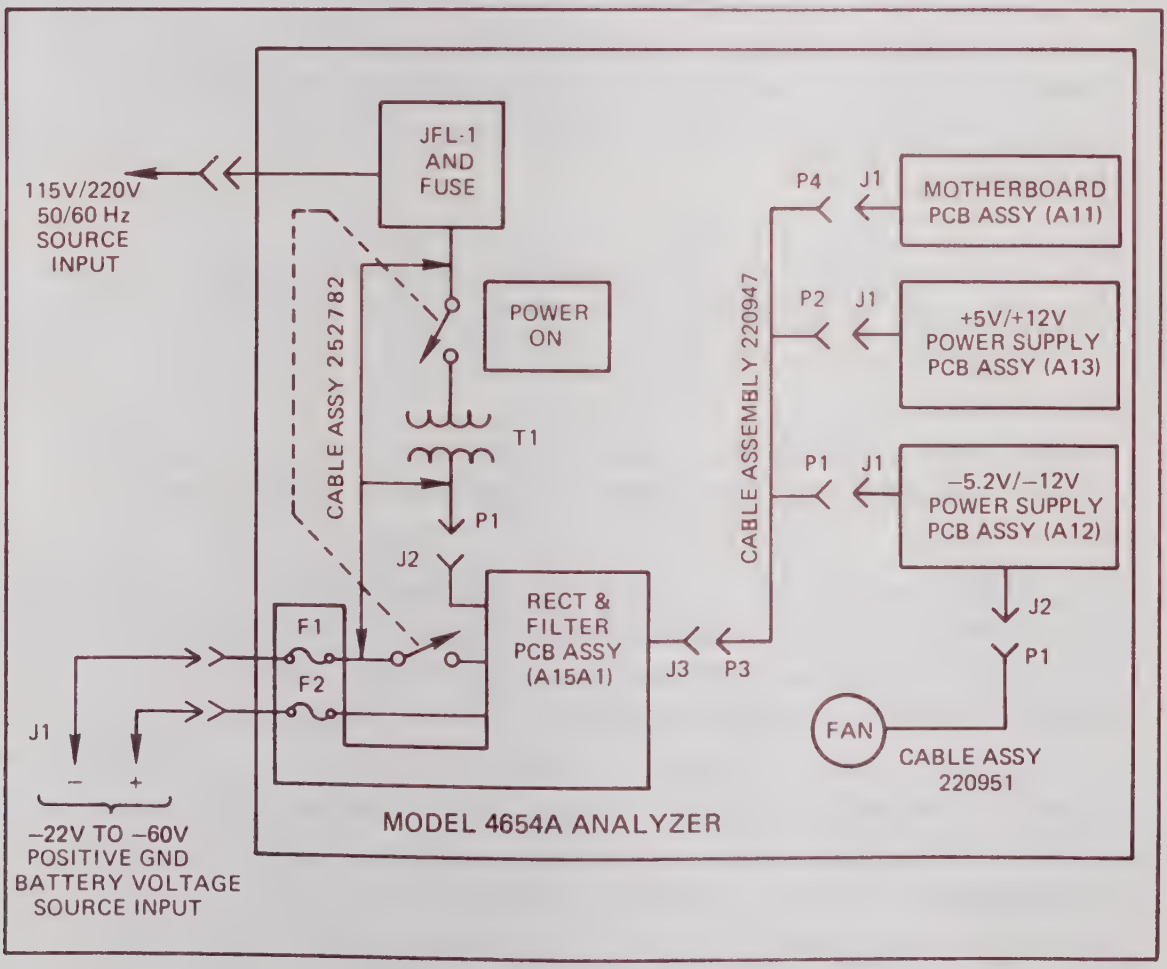


Figure 4.4. Input AC/DC Power Source Distribution Block Diagram

If a Station Battery dc source of -22V to -60V (positive ground) is applied to the rear panel DC INPUT connector (J1), both the source and the equipment are fuse protected (F1 and F2 on the Rectifier and Filter Assembly PCB). The negative source line is interrupted by contacts of the front panel POWER ON switch. When closed, the switch contacts apply the battery source voltage through a filter network of L1, C1, C2, and C3 to a terminal of diode bridge CR2. The filter network removes induced noise components and transients from reflecting into the Station Battery source. A diode, CR1, is part of this filtering network and also provides protection should the Station Battery source polarity be accidentally reversed.

The two dc sources are connected at specific terminals of diode bridge CR2. The source having the larger potential will be passed by its respective diode in the CR2 bridge and reverse biasing the opposite source diode from conduction. In this manner, the two power sources are diode ORed, the larger potential supplying operating power, and the lower potential in ready reserve if needed.

Power distribution from the Rectifier and Filter Assembly PCB for a Model 4654A Analyzer is shown in Figure 4.4. The diagram shows power distribution to the boards and fan identical, but the A-numbers for the various assemblies are different.

B. -5.2V/-12V DC POWER SUPPLY PRINTED CIRCUIT BOARD ASSEMBLY

General. The -5.2V/-12V DC Power Supply PCB uses a pulse width modulation circuit where varying the duty cycle of a fixed frequency pulse stream produces an adjustable regulated dc voltage output. The output is sensed and fed back into the pulse width modulator which controls pulse width as needed to maintain a constant voltage. A block diagram of the -5.2V/-12V DC Power Supply PCB Assembly is shown in Figure 4.5. Components U1 and U3 each contain all the active circuitry necessary to implement a pulse width modulator except for the power switching transistor. Components used with U1 or U3 are necessary to set the desired operating frequency, provide voltage adjustment, or other supporting functions. Other circuitry included on the PCB assembly pro-

vides for overvoltage protection, voltage regulation, and feedback control. In summary, a -22V to -60V dc input is switched through power transistors, under control of a pulse width modulator, to produce regulated -5.2V and -12.0V dc source supplies.

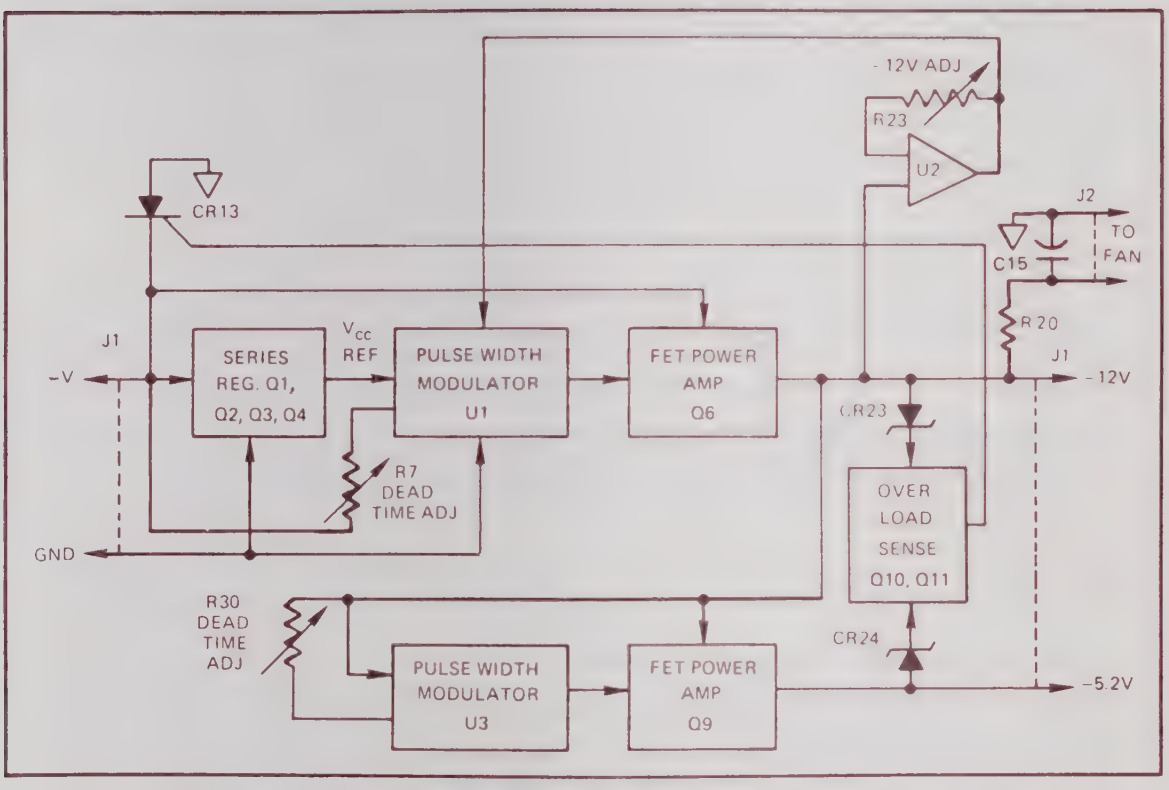


Figure 4.5. The -5.2V/-12V DC Power Supply PCB Assembly, Block Diagram

Series Regulator Circuit. The schematic diagram for the -5.2V/-12V dc Power Supply PCB Assembly is shown in Figure 7.26. A regulated voltage is required to operate a pulse width modulator circuit. The applied source voltage of -22V to -60V must also be regulated to supply a nominal 12V to pulse width modulator U1. Transistors Q1 through Q4 and associated components are connected as a series regulator producing a 12V output for U1. Note that the "-V" input is common to the series regulator circuit and the pulse width modulator. The regulator output, measured at test point TP1, will be +12 volts higher than the applied -22V to -60V input and not referenced to ground. The

diode CR5 provides reverse voltage protection, while zener diode CR6, provides overvoltage protection for U1.

-12V DC Switching Regulator. All regulated dc sources produced by the Model 4564A power supply use an SG3524 (or equivalent) Pulse Width Modulator component. A typical data sheet specifying the parameters of the SG3524 are provided in Figure 4.6 (8 sheets) describing the internal operation. The following description details the external component connections and their respective interaction with the Pulse Width Modulator (hereafter referred to as the PWM).

The PWM provides an internally stabilized reference voltage at pin 16 which is used as reference for "Dead Time Adjust" as well as several bias voltages. The "Dead Time Adjust" corresponds to the time when the PWM outputs are forced OFF. This is required in push-pull arrangements to guarantee that both outputs cannot be ON simultaneously. When used as a single-ended drive (see Figure 7.26), "Dead Time Adjust" establishes the maximum output current by setting the maximum duty cycle. Variable resistor R7 (Dead Time Adjust for U1) is properly set by operating the -5.2V/-12V Power Supply PCB into a full load with a minimum input potential (-22V dc). Variable resistor R7 is adjusted, with minimum input potential (-22V dc), clockwise to a point where the reference voltage (at U1, pin 16) starts going out-of-regulation and is then reversed two turns, counterclockwise. The reference voltage is also divided by resistors R10 and R11 to bias the unused "plus" input of the internal amplifier (U1, pin 2) to an acceptable midrange point. The reference voltage is divided by resistors R16 and R17 to establish the current limit reference (U1, pin5) to approximately 3.5 Amperes. Components R8 and C6 will hold the PWM outputs OFF momentarily on initial power-up to allow voltages to stabilize before the PWM begins to regulate.

Components C10 and R14 determine the PWM operating frequency at 40 kHz. Since the push-pull outputs of the PWM (U1, pins 11 and 14) are connected together, the drive signal into the gate of transistor Q6 will also be 40 kHz. This driving signal can be monitored at test point TP3. Capacitor C11, connected to the PWM oscillator output (U1, pin 3), sets the minimum "Dead Time"

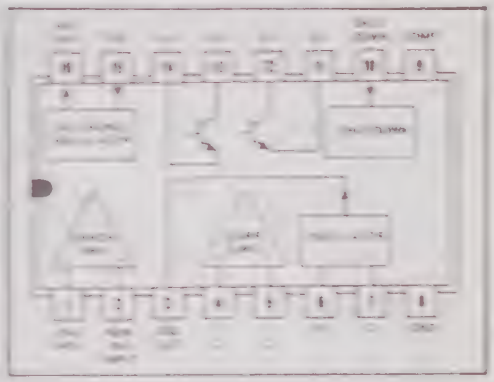
LINEAR INTEGRATED CIRCUITS

TYPES SG1524, SG2524, SG3524 REGULATING PULSE WIDTH MODULATORS

BULLETIN NO. DL-S 7512489, APRIL 1977

- Complete PWM Power Control Circuitry
- Uncommitted Outputs for Single-Ended or Push-Pull Applications
- Low Standby Current . . . 8 mA Typ
- Interchangeable With Silicon General SG1524, SG2524, and SG3524 Respectively

SG1524 . . . J
SG2524, SG3524 . . . J OR N
DUAL-IN-LINE PACKAGE (TOP VIEW)

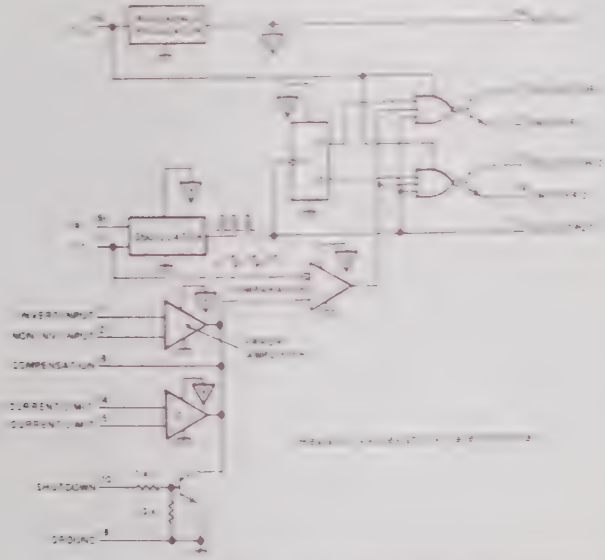


description

The SG1524, SG2524, and SG3524 incorporate on single monolithic chips all the functions required in the construction of a regulating power supply, inverter, or switching regulator. They can also be used as the control element for high-power-output applications. The SG1524 family was designed for switching regulators of either polarity, transformer-coupled dc-to-dc converters, transformerless voltage doublers, and polarity converter applications employing fixed-frequency, pulse-width-modulation techniques. The complementary output allows either single-ended or push-pull application. Each device includes an on-chip regulator, error amplifier, programmable oscillator, pulse-steering flip-flop, two uncommitted pass transistors, a high-gain comparator, and current-limiting and shut-down circuitry.

The SG1524 is characterized for operation over the full military temperature range of −55°C to 125°C. The SG2524 and SG3524 are characterized for operation from 0°C to 70°C.

functional block diagram



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Courtesy of Texas Instruments

Figure 4.6. Pulse Width Modulator SG3524, Data Sheets (Sheet 1 of 8)

TYPES SG1524, SG2524, SG3524
REGULATING PULSE WIDTH MODULATORS

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply Voltage, V_{CC} (See Notes 1 and 2)	40 V
Collector Output Current	100 mA
Reference Output Current	50 mA
Current Through C_T Terminal	−5 mA
Continuous Total Dissipation at (or below) 25°C Free-Air Temperature (See Note 3)	1000 mW
Operating Free-Air Temperature Range: SG1524	−55°C to 125°C
SG2524, SG3524	0°C to 70°C
Storage Temperature Range	−65°C to 150°C

NOTES: 1. All voltage values are with respect to network ground terminal
2. The reference regulator may be bypassed for operation from a fixed 5-volt supply by connecting the V_{CC} and reference output pins both to the supply voltage. In this configuration the maximum supply voltage is 6 volts.
3. For operation above 25°C free-air temperature, see Dissipation Derating Curves, page 124.

recommended operating conditions

	SG1524		SG2524, SG3524		UNIT
	MIN	MAX	MIN	MAX	
Supply voltage, V_{CC}	8	40	8	40	V
Reference output current	0	50	0	50	mA
Current thru C_T terminal	−0.03	−2	−0.03	−2	mA
Timing resistor, R_T	1.8	100	1.8	100	kΩ
Timing capacitor, C_T	0.001	0.1	0.001	0.1	μF
Operating free-air temperature	−55	125	0	70	°C

electrical characteristics over recommended operating free-air temperature range, V_{CC} = 20 V, f = 20 kHz (unless otherwise noted)

reference section

PARAMETER	TEST CONDITIONS†	SG1524			SG2524			SG3524			UNIT
		MIN	TYP‡	MAX	MIN	TYP‡	MAX	MIN	TYP‡	MAX	
Output voltage		4.8	5	5.2	4.8	5	5.2	4.6	5	5.4	V
Input regulation	V_{CC} = 8 to 40 V		10	20		10	20		10	30	mV
Ripple rejection	f = 120 Hz		66			66			66		dB
Output regulation	I_O = 0 to 20 mA		20	50		20	50		20	50	mV
Output voltage change with temperature	T_A = MIN to MAX		0.6	2		0.3	1		0.3	1	%
Short-circuit output current §	V_{ref} = 0		100			100			100		mA

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
‡ All typical values except output voltage change with temperature are at T_A = 25°C
§ Duration of the short-circuit should not exceed one second

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Figure 4.6. Pulse Width Modulator SG3524, Data Sheets (Sheet 2 of 8)

electrical characteristics over recommended operating free-air temperature range, V_{CC} = 20 V, f = 20 kHz (unless otherwise noted)

error amplifier section

PARAMETER	TEST CONDITIONS	SG1524, SG2524			SG3524			UNIT
		MIN	TYP‡	MAX	MIN	TYP‡	MAX	
Input offset voltage	V_{IC} = 2.5 V		0.5	5		2	10	mV
Input bias current	V_{IC} = 2.5 V		2	10		2	10	μA
Open-loop voltage amplification		72	80		60	80		dB
Common-mode input voltage range	T_A = 25°C	1.8 to 3.4			1.8 to 3.4			V
Common-mode rejection ratio			70			70		dB
Unity-gain bandwidth			3			3		MHz
Output swing	T_A = 25°C	0.5		3.8	0.5		3.8	V

oscillator section

PARAMETER	TEST CONDITIONS†	MIN	TYP‡	MAX	UNIT
Frequency	C_T = 0.001 μF, R_T = 2 kΩ		450		kHz
Standard deviation of frequency§	All values of voltage, temperature, resistance, and capacitance constant		5		%
Frequency change with voltage	V_{CC} = 8 to 40 V, T_A = 25°C			1	%
Frequency change with temperature	T_A = MIN to MAX			2	%
Output amplitude at pin 3			3.5		V
Output pulse width at pin 3	C_T = 0.01 μF		0.5		μs

comparator section

PARAMETER	TEST CONDITIONS	MIN	TYP‡	MAX	UNIT
Maximum duty cycle, each output		45			%
Input threshold voltage at pin 9	Zero duty cycle		1		V
	Maximum duty cycle		3.5		
Input bias current			-1		μA

current limiting section

PARAMETER	TEST CONDITIONS	SG1524, SG2524			SG3524			UNIT
		MIN	TYP‡	MAX	MIN	TYP‡	MAX	
Input voltage range (either input)		-0.7 to +1			-0.7 to +1			V
Sense voltage for 2-V output at pin 9	V(pin 2) − V(pin 1) ≥ 50 mV, T_A = 25°C	190	200	210	180	200	220	mV
Sense voltage	T_A = MIN to MAX		0.2			0.2		mV/°C

†For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡All typical values except for temperature coefficients are at T_A = 25°C.

§Standard deviation is a measure of the statistical distribution about the mean as derived from the formula $\sigma = \sqrt{\frac{\sum (X_n - X)}{N - 1}}$

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Figure 4.6. Pulse Width Modulator SG3524, Data Sheets (Sheet 3 of 8)

TYPES SG1524, SG2524, SG3524
REGULATING PULSE WIDTH MODULATORS

electrical characteristics over recommended operating free-air temperature range, V_{CC} = 20 V, f = 20 kHz (unless otherwise noted)

output section

PARAMETER	TEST CONDITIONS		MIN	TYP‡	MAX	UNIT
Collector-emitter breakdown voltage			40			V
Collector off-state current	V_{CE} = 40 V			0.01	50	μA
Collector-emitter saturation voltage	I_C = 50 mA			1	2	V
Emitter output voltage	V_C = 20 V,	I_E = −250 μA	17	18		V
Turn-off voltage rise time	R_C = 2 kΩ			0.2		μs
Turn-on voltage fall time	R_C = 2 kΩ			0.1		μs

total device

PARAMETER	TEST CONDITIONS		MIN	TYP‡	MAX	UNIT
Standby current	V_{CC} = 40 V, Pin 2 at 2 V,	Pins 1,4,7,8,9,11,14 grounded, All other inputs and outputs open		8	10	mA

‡ All typical values except for temperature coefficients are at T_A = 25°C

PARAMETER MEASUREMENT INFORMATION

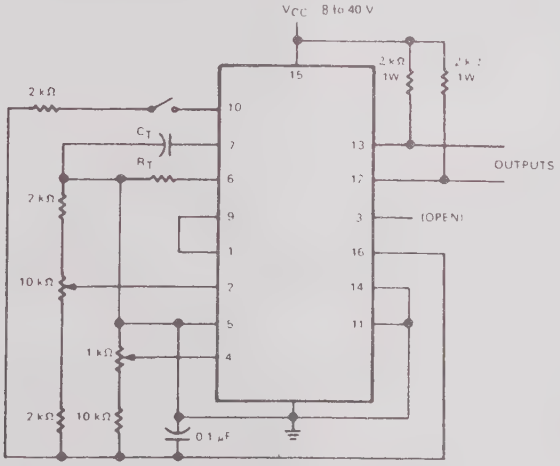
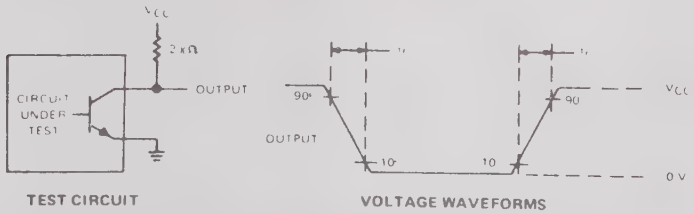


FIGURE 1–GENERAL TEST CIRCUIT



TEST CIRCUIT VOLTAGE WAVEFORMS

FIGURE 2–SWITCHING TIMES

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Figure 4.6. Pulse Width Modulator SG3524, Data Sheets (Sheet 4 of 8)

TYPICAL CHARACTERISTICS

OPEN-LOOP VOLTAGE AMPLIFICATION
OF ERROR AMPLIFIER
vs
FREQUENCY

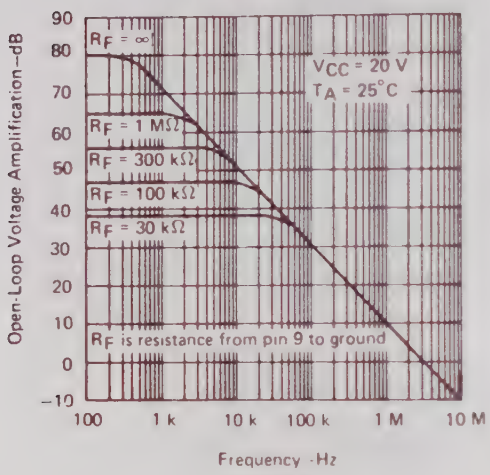

FIGURE 3

OSCILLATOR FREQUENCY
vs
TIMING RESISTANCE

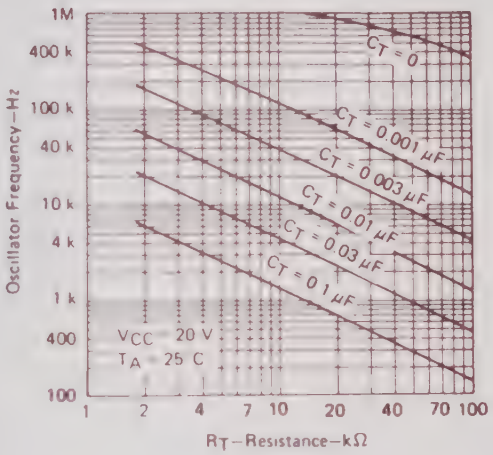

FIGURE 4

OUTPUT DEAD TIME
vs
TIMING CAPACITANCE VALUE

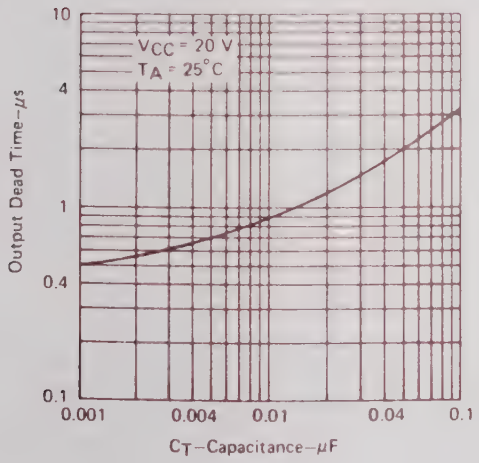

FIGURE 5

Figure 4.6. Pulse Width Modulator SG3524, Data Sheets (Sheet 5 of 8)

TYPES SG1524, SG2524, SG3524
REGULATING PULSE WIDTH MODULATORS

PRINCIPLES OF OPERATION

The SG1524† is a fixed-frequency pulse-width-modulation voltage-regulator control circuit. The regulator operates at a fixed frequency that is programmed by one timing resistor R_T and one timing capacitor C_T. R_T establishes a constant charging current for C_T. This results in a linear voltage ramp at C_T, which is fed to the comparator providing linear control of the output pulse width by the error amplifier. The SG1524 contains an on-board 5-volt regulator that serves as a reference as well as supplying the SG1524's internal regulator control circuitry. The internal reference voltage is divided externally by a resistor ladder network to provide a reference within the common-mode range of the error amplifier as shown in Figure 6, or an external reference may be used. The output is sensed by a second resistor divider network and the error signal is amplified. This voltage is then compared to the linear voltage ramp at C_T. The resulting modulated pulse out of the high-gain comparator is then steered to the appropriate output pass transistor (Q1 or Q2) by the pulse-steering flip-flop, which is synchronously toggled by the oscillator output. The oscillator output pulse also serves as a blanking pulse to assure both outputs are never on simultaneously during the transition times. The width of the blanking pulse is controlled by the value of C_T. The outputs may be applied in a push-pull configuration in which their frequency is half that of the base oscillator, or paralleled for single-ended applications in which the frequency is equal to that of the oscillator. The output of the error amplifier shares a common input to the comparator with the current-limiting and shut-down circuitry and can be overridden by signals from either of these inputs. This common point is also available externally and may be employed to control the gain of, or to compensate, the error amplifier, or to provide additional control to the regulator.

TYPICAL APPLICATION DATA

oscillator

The oscillator controls the frequency of the SG1524 and is programmed by R_T and C_T as shown in Figure 4.

$$f \approx \frac{1.15}{R_T C_T}$$

where R_T is in kilohms
C_T is in microfarads
f is in kilohertz

Practical values of C_T fall between 0.001 and 0.1 microfarad. Practical values of R_T fall between 1.8 and 100 kilohms. This results in a frequency range typically from 140 hertz to 500 kilohertz.

blanking

The output pulse of the oscillator is used as a blanking pulse at the output. This pulse width is controlled by the value of C_T as shown in Figure 5. If small values of C_T are required, the oscillator output pulse width may still be maintained by applying a shunt capacitance from pin 3 to ground.

synchronous operation

When an external clock is desired, a clock pulse of approximately 3 volts can be applied directly to the oscillator output terminal. The impedance to ground at this point is approximately 2 kilohms. In this configuration R_T C_T must be selected for a clock period slightly greater than that of the external clock.

If two or more SG1524 regulators are to be operated synchronously, all oscillator output terminals should be tied together. The oscillator programmed for the minimum clock period will be the master from which all the other SG1524's operate. In this application, the C_T R_T values of the slaved regulators must be set for a period approximately 10% longer than that of the master regulator. In addition, C_T (master) = 2 C_T (slave) to ensure that the master output pulse, which occurs first, has a wider pulse width and will subsequently reset the slave regulators.

† Throughout these discussions, references to SG1524 apply also to SG2524 and SG3524

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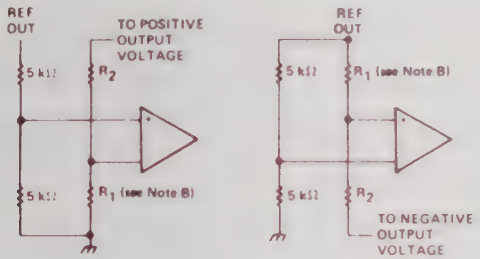
Figure 4.6. Pulse Width Modulator SG3524, Data Sheets (Sheet 6 of 8)

TYPICAL APPLICATION DATA

voltage reference

The 5-volt internal reference may be employed by use of an external resistor divider network to establish a reference within the error amplifiers common-mode voltage range (1.8 to 3.4 volts) as shown in Figure 6, or an external reference may be applied directly to the error amplifier. For operation from a fixed 5-volt supply, the internal reference may be bypassed by applying the input voltage to both the V_{CC} and V_{REF} terminals. In this configuration, however, the input voltage is limited to a maximum of 6 volts.



$$V_O \approx 2.5\,V\frac{R1 + R2}{R1} \qquad \frac{R1\,R2}{R1 + R2} \approx 2.5\,k\Omega$$

FIGURE 6–ERROR AMPLIFIER BIAS CIRCUITS

error amplifier

The error amplifier is a differential-input transconductance amplifier. The output is available for dc gain control or ac phase compensation. The compensation node (pin 9) is a high-impedance node (R_L = 5 megohms). The gain of the amplifier is $A_V = (0.002\ \Omega^{-1})\ R_L$ and can easily be reduced from a nominal 10,000 by an external shunt resistance from pin 9 to ground. Refer to Figure 3 for data

compensation

Pin 9, as discussed above, is made available for compensation. Since most output filters will introduce one or more additional poles at frequencies below 200 hertz, which is the pole of the uncompensated amplifier, introduction of a zero to cancel one of the output filter poles is desirable. This can best be accomplished with a series RC circuit from pin 9 to ground in the range of 50 kilohms and 0.001 microfarads. Other frequencies can be canceled by use of the formula $f \approx 1/RC$.

shut down circuitry

Pin 9 can also be employed to introduce external control of the SG1524. Any circuit that can sink 200 microamperes can pull the compensation terminal to ground and thus disable the SG1524.

In addition to constant-current limiting, pins 4 and 5 may also be used in transformer-coupled circuits to sense primary current and shorten an output pulse should transformer saturation occur. Pin 5 may also be grounded to convert pin 4 into an additional shutdown terminal.

Figure 4.6. Pulse Width Modulator SG3524, Data Sheets (Sheet 7 of 8)

TYPICAL APPLICATION DATA

current limiting

A current-limiting sense amplifier is provided in the SG1524. The current-limiting sense amplifier exhibits a threshold of 200 millivolts and must be applied in the ground line since the voltage range of the inputs is limited to +1 volt to −0.7 volt. Caution should be taken to ensure the −0.7-volt limit is not exceeded by either input, otherwise damage to the device may result.

Fold-back current limiting can be provided with the network shown in Figure 7. The current-limit schematic is shown in Figure 8.

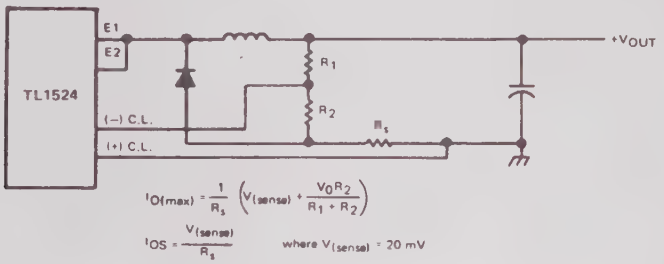


FIGURE 7–FOLDBACK CURRENT LIMITING FOR SHORTED OUTPUT CONDITIONS

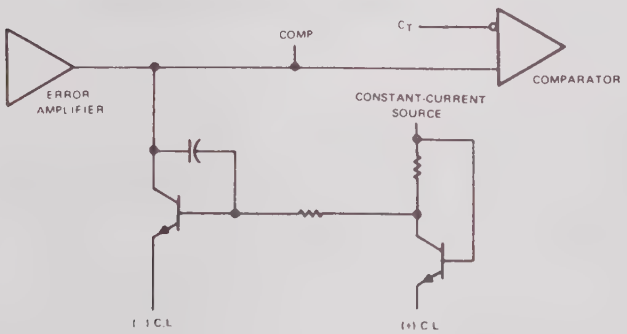


FIGURE 8–CURRENT-LIMIT SCHEMATIC

output circuitry

The SG1524 contains two identical n-p-n transistors the collectors and emitters of which are uncommitted. Each transistor has antisaturation circuitry that limits the current through that transistor to a maximum of 100 milliamperes for fast response.

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Figure 4.6. Pulse Width Modulator SG3524, Data Sheets (Sheet 8 of 8)

to be greater than 0.5 microseconds. Resistor R13 biases the Shutdown Input (U1, pin 10) to a level where this function has no effect on the PWM operation. Components L1 and C8 filter the feedback signal applied to the Current Limit Sense (+C.L. Sense at U1, pin 4). If the Current Limit voltage developed across resistor R18 permits the voltage at -C.L. Sense (U1, pin 5) to exceed the voltage at +C.L. Sense (U1, pin 4), the PWM will not widen the pulse width to permit an increase in output current.

The collectors of the PWM output transistors are connected to the V_{CC} input source and the emitters are connected together to drive the switching power transistor, Q6. Components R15, Q5, and CR9 increase the drive capability by providing rapid discharge of Q6 Gate capacitance. This effects a rapid turn-off as well as turn-on. The switching power transistor, Q6, is a FET device that is OFF (or open circuit) when V_{GS} equals 0V dc and ON (or closed circuit with 0.25 ohm max) when V_{GS} equals 10V dc. Diode CR10 protects Q6 from reverse voltage. Network components L2, CR11, and R19 reduce ringing and overvoltage transients on the Drain of Q6. The final -12V dc output is filtered by components L3, C17, L4, and C28 with diode CR12 providing a current path for the inductors when transistor Q6 is switched OFF.

Feedback control and frequency compensation for the PWM is made from a -12V dc source, regulated by component U2 through transistor Q7 which provides level shifting. Variable resistor R23 is adjusted to produce the -12V dc output while components C16, R21, C18, R28, C9, and R12 provide frequency compensation. Components CR14 and R26 provide bias voltage for the "plus" input of component U2.

The separate -12V dc source used to operate the fan is additionally filtered by components R20 and C15 to isolate the dc fan from the PWM. Diode CR23, transistor Q10, and connecting components, provide an overvoltage protection "crowbar" circuit. When the output voltage exceeds approximately 15V dc, transistor Q10 is switched ON and triggers the SCR diode, CR13, to short the -V input and blow the appropriate input fuse. Resistor R25 is rated at 100-ohms/3 Watts, and is provided to load the -12V dc supply when normal loads are removed. This is necessary because this switching power supply cannot op-

erate into a zero load condition. Some loading must exist for the circuit to remain in regulation.

-5.2V DC Switching Regulator. In principle, the -5.2V dc switching regulator circuit operates identically to the -12V dc switching regulator circuit. There are several circuit changes to accommodate the different voltage range. The first difference to be noted is that the PWM U3 operates between the regulated -12V dc supply and ground, rather than the floating supply used with PWM U1. The schematic (Figure 7.26) show PWM U3, pin 15 is grounded and U3, pin 8 connects to the regulated -12V dc source. The operating frequency used by PWM U3 is set for 65 kHz, which drives the Gate of transistor Q9. This driving frequency can be monitored at test point TP3. The frequency is higher to simplify the necessary filtering for the -5.2V dc output which can exceed 3.0 Amperes when required.

The feedback component U4 drives transistor Q12 as a current source configuration into the PWM U3. Note that the PWM internal amplifiers are not used and the feedback signal is applied, instead, to the compensation input of the PWM. An overvoltage detector circuit using diode CR24, transistor Q11, and connected components are set to trigger at approximately 7 volts dc. This trigger signal also operates SCR diode, CR13, to short the -V input and blow the appropriate input fuse if an overvoltage condition exists. Resistor R50, rated at 50-ohms/3 Watts, loads the -5.2V dc supply when other loads are removed. This supply also requires a partial load to remain in regulation.

C. +5.0V/+12.0V DC POWER SUPPLY PRINTED CIRCUIT BOARD ASSEMBLY

General. A block diagram of the +5.0V/+12.0V dc Power Supply PCB is shown in Figure 4.7. This power supply assembly operates similar to the -5.2V/-12V dc Power Supply circuits. The major difference is the negative supply chops the -22V to -60V applied voltage into regulated sources, while this supply requires a transformer to generate positive output voltages from the negative voltage input. The +12V supply PWM operates from the same voltage source as the -12V supply PWM, but the +12V supply output signals drive a

differential transformer. The +5V supply PWM operates from the regulated +12V dc output and does not require a transformer.

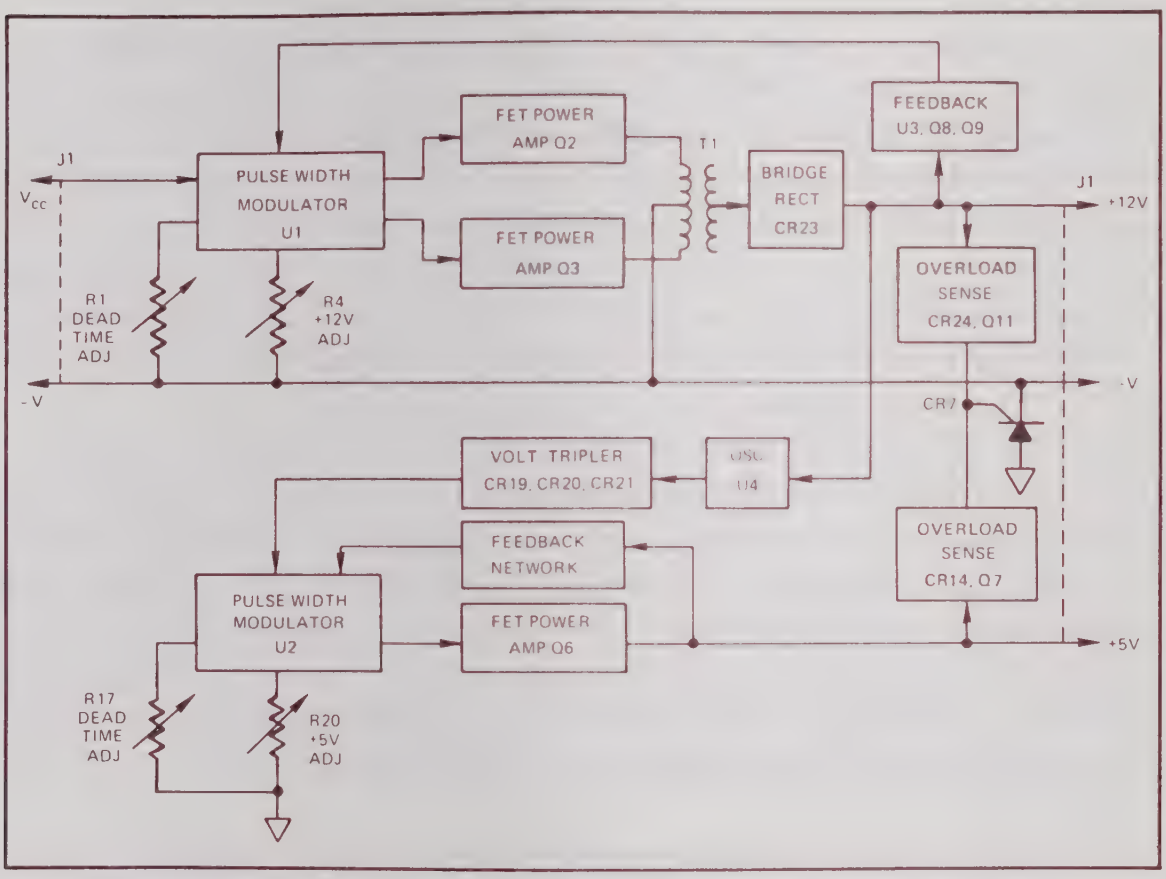


Figure 4.7. The +5.0V/+12.0V DC Power Supply PCB Assembly, Block Diagram

+12V DC Switching Regulator. The schematic diagram for the +5.0V/+12.0V dc Power Supply PCB Assembly is shown in Figure 7.28. When the +5.0V/+12.0V dc Power Supply PCB Assemby is used, it is interconnected with the -5.2V/-12.0V dc Power Supply PCB Assembly through Cable Assembly 220947 which make the functions "-V", "V_{CC}", and "GND" common to both supply assemblies. The +12V dc PWM, U1, uses the common functions to operate very similar to the -12V dc switching regulator. Components C5 and R9 set the operating frequency to 40 kHz, while capacitor C6 maintains a minimum "Dead Time" at not less than 0.5 microseconds. Current limiting, "Dead Time Adjust" (through variable re-

sistor R1) and the power-up delay functions, are also similar to the -5.2V/ -12.0V dc Power Supply PCB Assembly.

However, the output signals from the +12V PWM drive FET Power Amplifiers Q2 and Q3 which, in turn, drive transformer T1 in a differential push-pull arrangement. The Gates of FET Power Amplifiers are driven through transistors Q1 and Q4 to improve the Gate drive signal rise and fall times. Capacitor C7 filters the dc voltage input to the transformer and components C8 and R14 load the transformer coil to reduce switching transients. The transformer secondary voltage is full-wave rectified by a fast recovery diode bridge, CR23; and the bridge output is filtered by components L4 and C28 to become the regulated +12.0V dc output voltage.

Resistors R39 and R40 divide voltage from the +12.0V dc output to establish a midrange input signal level for component U3. This input signal is amplified and then level shifted through transistors Q8 and Q9 to provide feedback voltage into the +12V dc PWM at VIN(-), pin 1. The feedback voltage controls the duty cycle of the FET Power Amplifier "Gate drive" signal to regulate the resulting +12V dc rectified signal. The VIN(+), pin 2, connects to variable resistor R4 which adjusts the final output voltage.

The circuit using transistor Q11, diode CR24, and associated components, provides overvoltage protection. If the output level exceeds approximately +15 volts, the overvoltage protection circuit operates SCR diode, CR7, until the input fuse blows. Resistor R43, rated at 100-ohms/3 Watts, loads the +12V dc supply when other loads are removed. This supply requires partial loading to maintain regulation.

+5V DC Switching Regulator. The +5V dc PWM derives operating power from the regulated +12V dc output. The +12V is applied to component U4 which operates as an oscillator, and the output frequency is rectified by a voltage tripler, CR19, CR20, and CR21. Voltage at the junction of diode CR19 and capacitor C8 is approximately +25V dc which is applied to the +5V PWM. The higher voltage is required to adequately raise the FET Power Amplifier "Gate drive" signal. The FET Power Amplifier, Q6, is also connected to the regulat-

ed +12V dc source. The Gate drive signal must be raised 10 volts higher to fully switch the FET Power Amplifier into the ON state.

Components C12 and R23 set the +5V PWM to operate at approximately 65 kHz, and capacitor C13 provides a minimum "Dead Time" in excess of 0.5 microseconds. Variable resistor R17 (DEAD TIME ADJ) will establish the maximum duty cycle of the output drive pulses. It is properly adjusted when the +5V dc supply output, operating into a full load with minimum dc input of -22V dc, starts to drop out of regulation as R17 is rotated clockwise. At this point, the adjustment is given two turns counterclockwise. Proper "Dead Time Adjustment" provides the maximum output current by setting the maximum duty cycle.

Components R18 and C9 provide a power-up delay to prevent PWM, U2, from trying to regulate until the applied power source voltage has stabilized. The PWM output drive transistor emitters are connected together and drive the FET power amplifier, Q6, Gate through components Q5, R24, CR10, and CR11. The signal, monitored at test point TP4, is a 0 to 25V pulse at 65 kHz. The FET power amplifier chops the +12V dc at 65 kHz into the regulated +5V dc with filtering provided by components L2 and C15. Diode CR13 provides a conduction path for current in L2 when the FET power amplifier (Q6) is switched OFF.

A feedback "sense" voltage is filtered by components C14, R25, and R22 and returned to the "-V" input of the PWM (U2, pin 1) to control the output voltage. Additional frequency compensation is provided through capacitor C10 connected at the PWM (U2, pin 9) Compensation input. Current limit sensing is not used directly on the +5V PWM (U2) because inputs to the +12V PWM (U1, pins 4 and 5) are grounded. In this circuit arrangement, current limit is better provided through the proper setting of "Dead Time Adjust" variable resistor R17. Components Q7 and CR14 provide an overvoltage sense circuit that operates at approximately +7V dc to enable SCR diode, CR7, to shut down the source supply if overvoltage occurs.

Power Fail Sense Circuit. Components R37, C17, CR17, Q10, and R31 are used as a circuit sensing when the source input voltage varies from the -22V dc minimum toward ground or 0V potential. This circuit also provides a signal

that will cause isolation of the Real-Time Clock and Nonvolatile RAM used in the Model 4654A Analyzer. The Real-Time Clock and Nonvolatile RAM have an internal battery backup system for operating power during isolation. The Real-Time Clock and Nonvolatile RAM are isolated from the microcomputer bus which may inadvertently change the clock setting or RAM contents during a power down.

If the applied source voltage is between -22V dc and -60V dc, all the current (approximately 1.5 mA) from Constant Current Diode CR17 flows through resistor R37 pulling the base of transistor Q10 below ground (clamped to -0.7V dc by diode CR18) and is switched OFF. If the "-V" input rises from -60V dc toward ground (or power fail condition), at approximately -19.95V (CR17 at 1.5 mA times R37 at 13.3K), resistor R37 can no longer take all the current from CR17 and current flows into the base of transistor Q10. As the "-V" input rises nearer ground potential, Q10 will eventually switch ON and pull the Power Fail to ground to isolate the Real-Time Clock and Nonvolatile RAM. Capacitor C17 provides a stored charge which is discharged through transistor Q10 as the "-V" input rises. This circuit action anticipates the "Power Fail" condition by at least 5 milliseconds.

4.3 MODEL 4654A AC LINEAR SUPPLIES

The Model 4654A Analyzer can be purchased with an AC-only linear power supply instead of the AC/DC switching power supply. The linear power supply provides a regulated +5V, +12V, -5V, and -12V dc overvoltage protection, and a power fail indication to the receiver's microprocessor and Real-Time Clock. A block diagram of the linear power supply is shown in Figure 4.8. The following descriptions identify the circuits in sections as shown in the block diagram. The schematic is shown in Figure 7.24.

The linear power supply consists of a power transformer, bridge rectifier, filter capacitor, voltage regulator, and an overvoltage protection circuit. The +12V supply also contains the power fail circuitry that warns the microprocessor that a power failure is occurring. The applied line voltage of

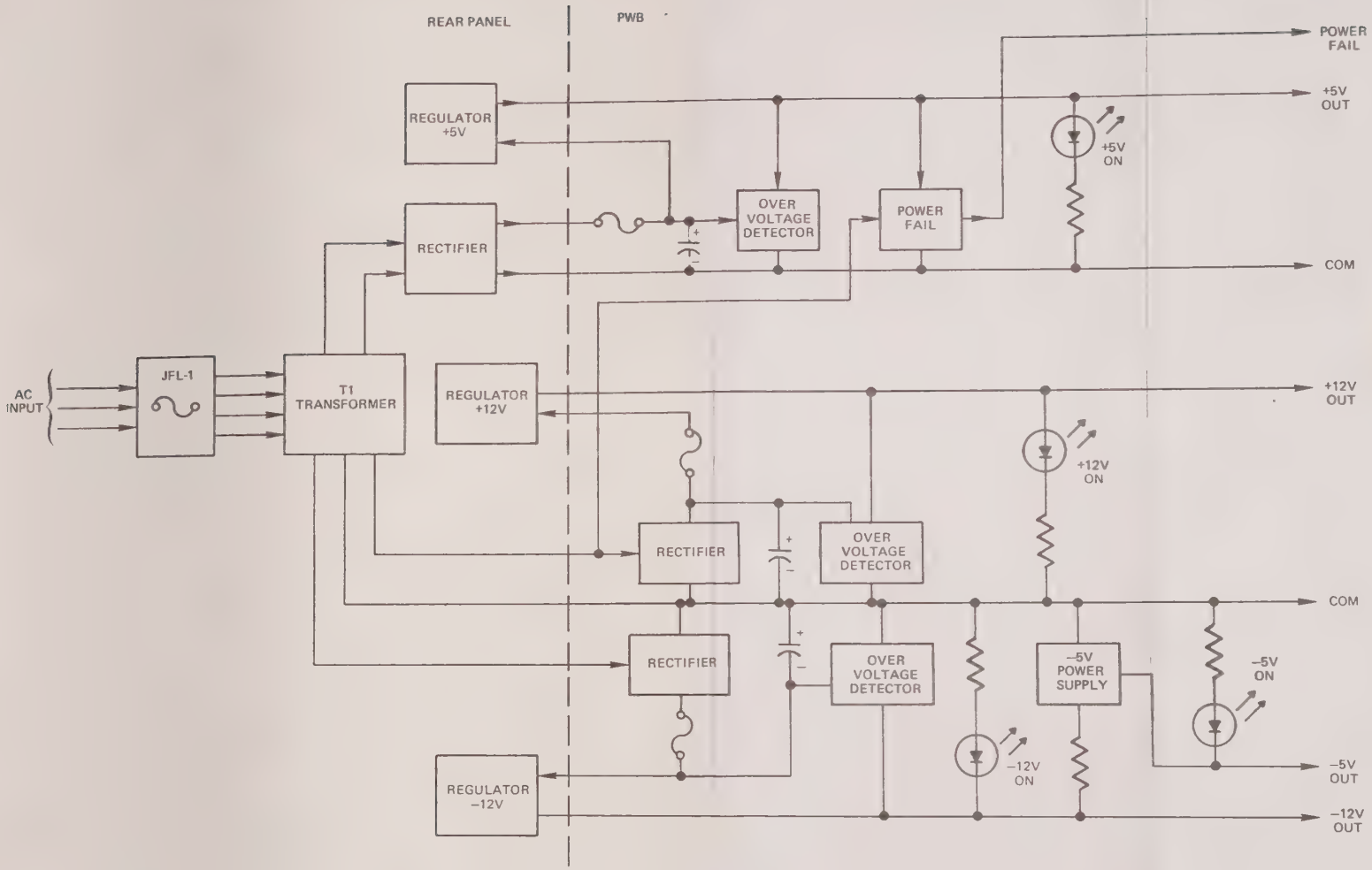


Figure 4.8. AC-Only Linear Power Supply, Block Diagram

120 volts or 240 volts, 50 or 60 Hz, is applied through the power cord to the rear panel Line Filter, Voltage Select, and fuse block unit (JFL-1). The position of the voltage select PCB and the proper value fuse in the JFL-1 unit permits normal operation with either applied voltage (See Figure 5.2.). The AC line voltage is interrupted by the front panel POWER ON switch.

When the POWER ON switch is operated, AC voltage is applied to the primary winding of power transformer T1. The two secondaries of T1 provide (1) a center-tapped voltage of 32V rms @ 2.6 Amps that is applied to a diode bridge for full wave rectification, and (2) a voltage of 10V rms @ 6.0 Amps that is applied to a diode bridge for full wave rectification. The 32V source drives the +12V, -12V, and the -5V power supplies. The 10V source drives the +5V power supply. All regulated power supplies are basically the same. Therefore, only one will be described in detail, the +12V power supply.

The positive rectified voltage from the diode bridge CR4, is applied across filter capacitor C6 to the input of voltage regulator U1 to provide a regulated output of +12V, which is adjustable by R12. (The +5V and -5V supplies are fixed output.) An overvoltage sensing circuit consisting of U2 and SCR Q2, protects sensitive components from overvoltage. If an overvoltage condition exists at the output of U1, component U2 senses it and enables the SCR Q2 which, in turn, shorts the input DC voltage to ground and blows the fuse F2. Diodes CR2, CR7, CR14, and CR15 are used in conjunction with the overvoltage sensing circuit to hold the voltage to a safe level until the fuse blows.

The +12V supply also contains a power fail circuit which warns the microprocessor that the power has failed in time for it to take appropriate action. The power fail circuit consists of CR9, CR10, CR16, C17, C18, R28, R29, R31, and Q5 and detects a sample of the secondary voltage of the +12V power supply. This voltage is rectified and filtered to give a negative DC voltage that is applied to the base of Q5 holding the collector high. If base voltage disappears, the base becomes positive very fast, turning the transistor on which pulls the power fail line low.

4.4 MODEL 4654A ANALYZER CIRCUITS

General. The Model 4654A ANALYZER consists of the following major assemblies and printed circuit boards.

Assemblies:

1. Rear Panel and Power Wiring
2. (a) -5.2V/-12.0V DC Power Supply (A12)
   (b) +5.0V/+12.0V DC Power Supply (A13)
   OR
   +12V/+5V/-12V/-5V Linear Power Supply (A12)
3. Front Panel Assembly (A14)

Printed Circuit Boards

1. Clock Recovery (A10)
2. Decoder/Detector (A9)
3. Frame Synchronizer (A8)
4. DS1 Framing (A7) (Optional)
5. Bit Error Detector (A6)
6. Error Counter (A5)
7. External Event Montior/Memory (A4) (304123)
8. Real-Time Clock (A2)
9. 8080 Processor (CPU) (A1)

The Model 4654A Analyzer may contain one of the following optional printed circuit boards in location A3:

1. IEEE-488 Bus Interface PCB (304208)
2. RS-232C Input/Output PCB (304209)

Also the 4654A Analyzer may contain the optional External Event Monitor/Memory PCB (304210) in location (A4).

The rear panel, power wiring, and power supply printed circuit boards have been described in Section 4.2. The rear panel contains connectors for the optional Model 4650 printer, the RS-232C or IEEE-488 Interface, the Ex-

ternal Event Monitor, and for remote control of the Model 4656 DS3 to DS2 Demultiplexer. The rear panel also contains five BNC connectors for accessing the Recovered Clock and Data, the PR-Sync and M-Sync pulses, and the selected error type. The Front Panel Assembly consists of four printed circuit boards which will be described separately from the removable printed circuit boards used in the card cage assembly. Major functions used in the Model 4654A Analyzer are shown by the block diagram in Figure 4.9.

A. FRONT PANEL ASSEMBLY (A14)

General. The front panel assembly contains four printed circuit boards which, when interconnected, provide all necessary front panel functions. The four printed circuit boards are: (1) Front Panel I/O PCB (A14A4), (2) Front Panel PCB (A14A1), (3) Front Panel Display (A14A2), and (4) Front Panel Indicator (A14A3). Circuit descriptions of the PCB assemblies are provided in the same order.

1. Front Panel I/O PCB (A14A4)

The schematic diagram of the Front Panel I/O PCB assembly is shown in Figure 7.35. Component U1 (an 8279 IC) provides a programmable keyboard/display interface circuit. It contains sixteen 8-bit memories for driving digital displays, the keyboard scanning logic, switch contact debouncing logic, programmable operating modes, and interrupt on key entry circuit functions. It is also compatible with functions of the 8080 microprocessor and, in this application, interfaces directly to the receiver microcomputer data bus through a flat cable from connector J1 to the Motherboard (A11). The Read (RD), Write (WR), Clock, Data Bus (DB0-DB7), Interrupt, and Address line functions are supplied by the 8080 Processor PCB (A1) and are described in that section.

Component U2 decodes I/O addresses 70H and 71H. The resulting output enables U1, through the $\overline{CS}$ input, to respond to these addresses. Note that the schematic shows switch, display, and indicator connections to the right of U1 for easy reference. The functions RL0-RL7 are the Return Line inputs from the

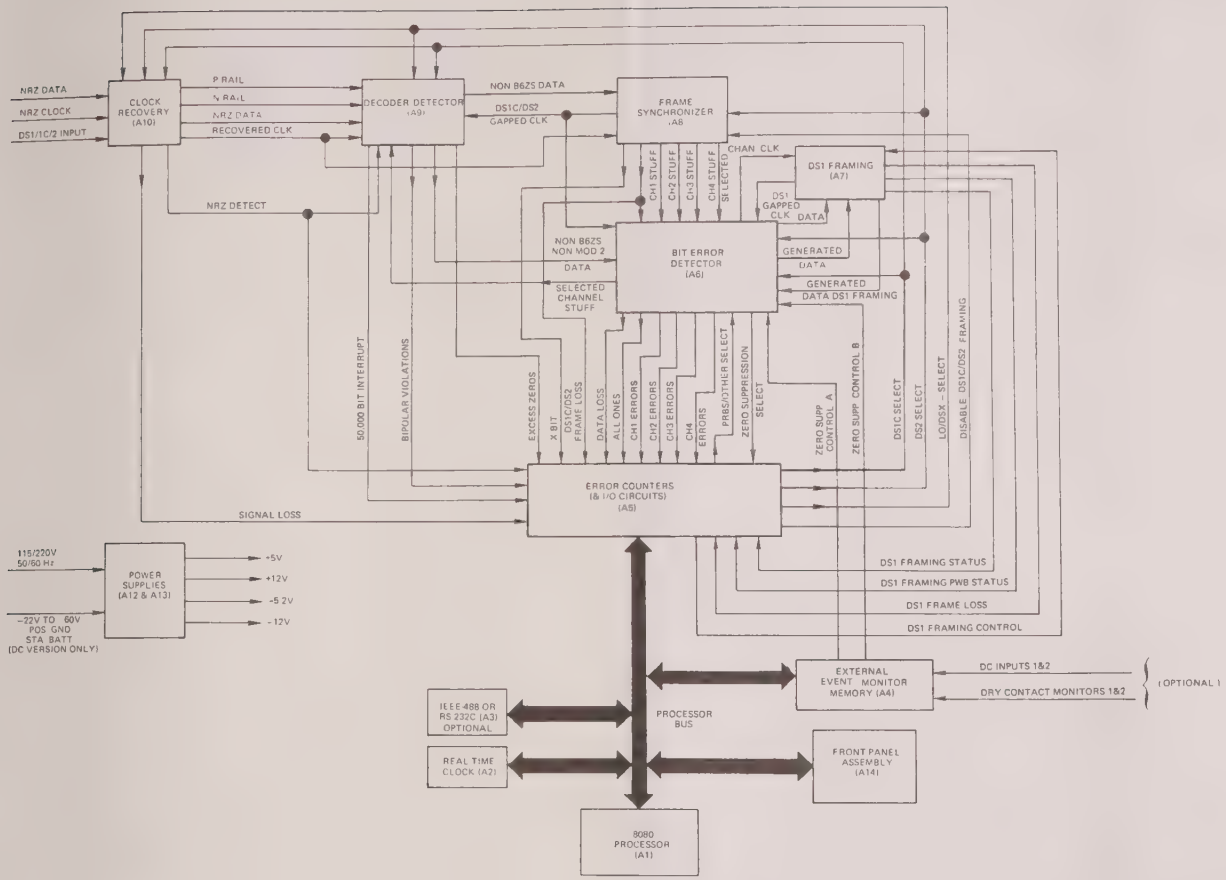


Figure 4.9. Model 4654A Analyzer, Block Diagram

Switch Scan. The functions SL0-SL3 are Scan Lines which simultaneously scan the front panel switch array and the displays. Component U4 decodes three of the Scan Lines into a 3-line code which is applied to a switch matrix of U5 and U6. All of the four Scan Lines are decoded by U5 and U6 and the outputs become Display Digit Enable signals.

The functions A0-A3 and B0-B3 are outputs from the 16-byte long by 8-bit wide internal RAM of U1. These RAM outputs are synchronized to Scan Lines codes so that data location 0 corresponds to Scan Line code equal to 0, etc. Component U3 buffers the display drivers to provide increased current for the display segment current source drivers on the Front Panel PCB (A14A1). Since the seven segment displays (plus one line for the decimal point) connect directly to U1, all necessary BCD-to-7 segment decoding is done in software. The discrete LED indicators used on the front panel are organized into groups of eight and are driven similar to the display digits. Transistor Q2 and diodes CR1 through CR8 provide bias reference voltages for the current source drive transistors.

2. Front Panel PCB (A14A1)

The schematic diagram of the Front Panel PCB assembly is shown in Figure 7.31. Note that the switches are interconnected in a matrix arrangement and also connect to the Scan Lines and Return Lines from the Front Panel Interface PCB (A14A4). The SHIFT switch (S1) is provided as a separate interface line so it can function as a SHIFT key for the other switches. Current source transistors, Q1 through Q8, interface with the Current Source Drivers on the Front Panel Interface PCB. Similarly, Digit Enable signals are interfaced with transistors Q9 through Q22 which drive the TIME display segments, the ERROR display segments, and discrete LED indicators (CR1 through CR49).

3. Front Panel Display PCB (A14A2)

The schematic diagram of the Front Panel Display PCB assembly is shown in Figure 7.31. The seven clock digits on this assembly are used to provide the front panel TIME display and the six error digits provide the front panel ERROR display. All digits are standard seven-segment-plus-decimal-point with

a common cathode. The segment and decimal anodes are interfaced with the current source transistor and the cathodes interface with the digit drive transistor provided on the Front Panel PCB assembly (A14A1). Two LED indicators, U8 and U9, are illuminated continuously to back light the TIME display colons. The Front Panel Display PCB also contains 27 discrete LEDs for the STATUS indicators and the indicators above the top row of pushbutton switches.

4. Front Panel Indicator PCB (A14A3)

The schematic diagram of the Front Panel Indicator PCB assembly is shown in Figure 7.31. This PCB assembly contains 22 discrete LEDs that provide the indicators above the bottom row of pushbutton switches. These LEDs are driven by U16 and U17 on the Front Panel Interface PCB (A14A4).

B. CLOCK RECOVERY PCB (A10)

A block diagram of the Clock Recovery PCB is shown in Figure 4.10. The schematic is shown in Figure 7.20. Circuits on this PCB perform the following functions: (1) provide automatic gain control (AGC) to hold a constant signal level for the data recovery circuits, (2) extract the clock signals needed to recover data and time the other circuits. The PCB assembly also contains a Signal Loss Detector, External Data and Clock Inputs with automatic switching circuits, and the DSX2 Cable Compensator circuits. If DS2-DSX or DS2-LO is front panel selected, the relay K1 will be energized and the input signal is routed into the DSX2 Compensation Network. This circuit uses components C2, L1, R2, R3, R4, and R5 in a "Bridged-T" network. The network compensates both signal phase and amplitude for 1,000 feet of 22 gauge ABAM cable. If there is no signal input, the Signal Loss Indicator will go low and the Recovered Clock Output will be the free running VCO frequency. When a signal and clock is applied to the external inputs, and no Bipolar signal is applied, the Recovered Clock Output will be External Clock. With the Bipolar input applied, the Recovered Clock Output will be a data phase-locked VCO signal. External Clock and Bipolar Input should not be applied simultaneously.

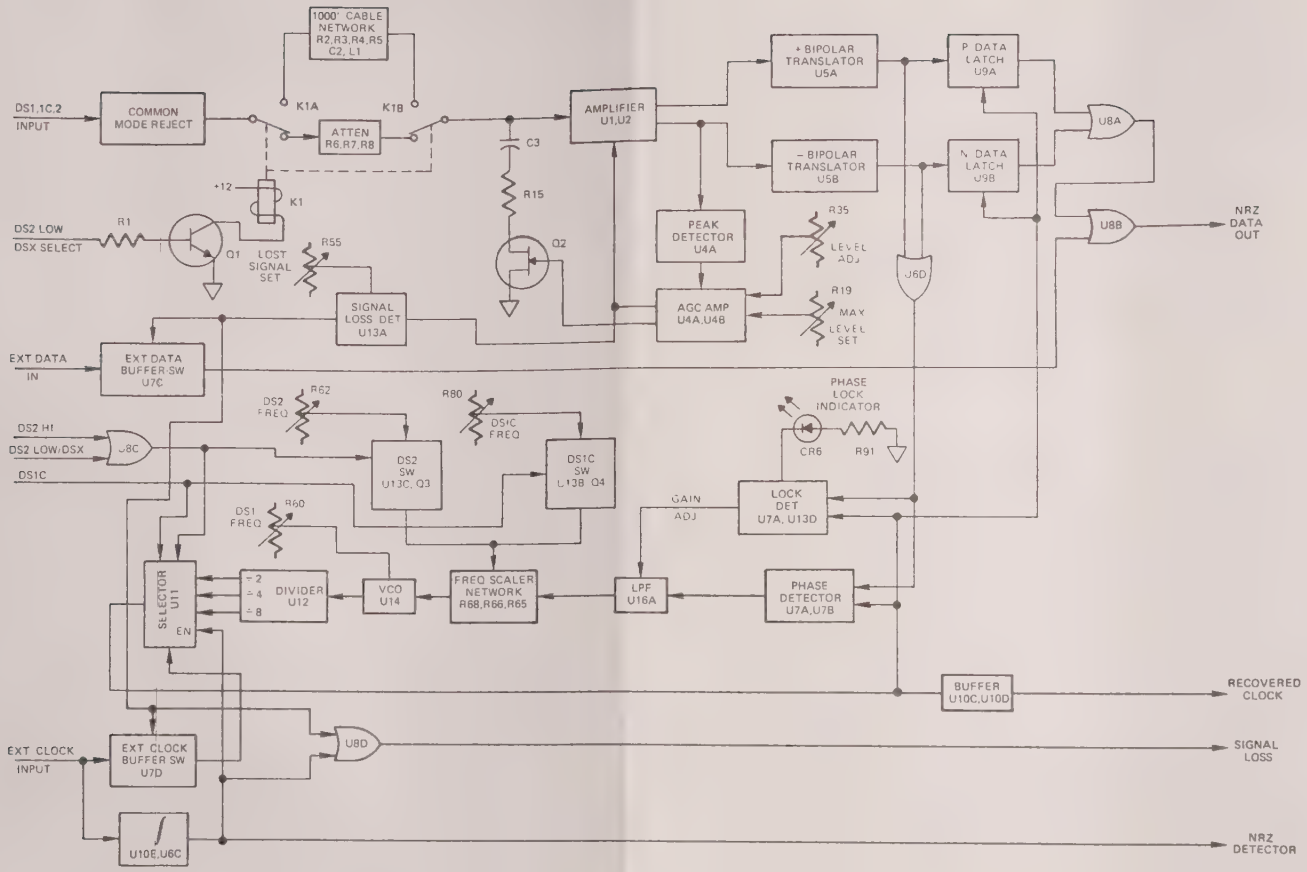


Figure 4.10. Clock Recovery PCB (A10), Block Diagram

When DS1, DS1C or DS2 HI are selected, the input Bipolar Signal is fed to the normally closed contacts of relay K1, and to an attenuation network (R6, R7, R8). The attenuated signal is passed to amplifiers U1 and U2. The amplified signal output is sent differentially from U2 and coupled to Line Receiver U5. U5 discriminates between Bipolar + or Bipolar - and translates these to a TTL level. The proper data is latched into flip-flop U9A or U9B which produces a NRZ data format. For DS2-DSX, and DS2 Low, the signal is fed through a 1000 ft. cable network to U1 and U2.

The signal output from one side of U2 is also coupled to the AGC peak detector through C17. Line Receiver U4 functions as a peak detector. Resistor dividers R26 and R27 produce a dc bias of approximately 0.6V. When the input signal is applied to pin 1 of U4A, the line receiver switches high and charges C22 through CR3. When C22 changes to the same value of the input peak plus the 0.6 bias voltage, then U4A switches low and CR3 is reverse biased. The peak dc level is fed to AGC amplifier U3A. The output of U3A is fed to the AGC control inputs of U1 and U2 through resistors R16 and R20. U1 and U2 adjust their gain proportionally to the dc voltage at their respective AGC control inputs. The signal level can be adjusted by controlling U3A bias level by R35. The output of U3A is also fed to non-inverting amplifier U3B, which controls attenuating transistor Q2. U3B and Q2 produce attenuation of large input signals. The level of the largest non-attenuated input signal is set by R19, the maximum level set.

The clock needed to generate the NRZ data is synchronized to the discriminated RZ data by a Phase Lock Loop. U7A and B are used as a missing pulse phase detector. U7A produces an error signal only when a data "one" is present and is a high impedance for a "zero." U7B generates a dc offset voltage of approximately 2V dc which prevents the loop filter (U16) from drifting due to dc offsets of the Phase detector. U7A produces a phase error voltage proportioned to the difference in data pulse width and clock pulse width. The RC integrator (C43, R75) and loop filter (U16A) filter the error voltage reducing the switching and high frequency components. The filtered output is fed to the resistor divider (R68, R66, R65) which limits the input voltage to the VCO for a full output swing of the loop filter. The Voltage Controlled Oscillator runs at a multiple of the desired frequency and is divided down by U12 to the

proper rate. U11 then passes the rate of the front panel selected mode. This selected signal is fed back to the phase detector U7A for comparison and U7B for development of a dc offset bias.

U17A, U13D, and Q5 form a lock detector and adjust the bandwidth of the loop accordingly. U17A samples the relative position of data and recovered clock. If they are in acceptable phasing, U17A output will be high and C50 will charge toward 5V dc. If the phasing is correct for enough consecutive periods for the voltage across C50 to exceed 3.9V, then CR6 is illuminated and Q5 turned off. If acceptable phasing is not consistent, then U13D output will be "high", CR6 will be off, and Q5 will be on. With Q5 on, the gain of the Op Amp Loop filter is increased, which increases the bandwidth and lock-in range of the loop. CR6 being brightly illuminated signifies phase lock. In order for the Phase Lock Loop to reach phase lock, the VCO frequency is required to be within ±500 Hz of the designated frequency. To accomplish this, U13B, U13C, Q3, and Q4 are used to switch in a fixed bias to center the VCO at the designated frequency. In DS1, both Q3 and Q4 are off and the DS1 frequency is set by R60. In DS1C, Q4 switches on and inputs a bias from R80. In DS2, Q3 switches on and inputs a bias from R62.

U13A determines the presence of a Bipolar input signal. If a Bipolar signal is present, the AGC voltage output from U3A will be 6.6V. If no Bipolar signal is present, the output of U3A will be about 8.4V. The Lost Signal Set Pot R55 will be set to a threshold such that Voltage Comparator U13A will switch to a low state when no Bipolar signal is present (~ 6.0V dc). The integrator C35, CR4, and R50 determine External Clock presence. If no external clock is present, gate U10E will be high and C35 will charge toward a high level which is inverted by U6C. If an External Clock signal is present, gate U10E will discharge C35 through CR4 during high portions of the clock period. The time constant of R50 and C35 is long enough to prevent C35 reaching a high level during the low portions of the clock period. U6C will invert the state of the integrator and force the output of U8D high, indicating signal input, and will select the External Clock (through U11) to be output on the Recovered Clock Output line. If neither a Bipolar Signal or an External Clock is present, U8D will output a low signal and signal loss will be indicated.

C. DECODER/DETECTOR PCB (A9)

A block diagram of the Decoder/Detector PCB is shown in Figure 4.11. The schematic is shown in Figure 7.18. The primary functions of this PCB are: (1) Detect Bipolar Violations, (2) B6ZS Decoding of DS2 Signals, (3) Modulo-2 Descrambling of DS1C data, and (4) Excess Zero detection. The card also contains a "divide-by-50,000" counter chain which provides bit interrupts to the microprocessor, and drivers to provide Recovered Clock and Data output to the BNC connectors on the rear panel.

Flip-flop U1A and gates U2A, B and D, are used to compare the polarity of the previous data "1" with the current data "1". If the polarity is the same, a bipolar violation has occurred and a "1" is output to shift register U3. The "1" is shifted through the shift register and finally is output from Q_5 of U3 to gate U2C where it is synchronized with the recovered clock and output to the Bipolar Violation counter chain on the Error Counter PCB (A5) where it is counted.

U1, U2 and U3 are also used along with U4, U6 and U7 to do the B6ZS decoding of the DS2 signal. In DS2, strings of six zeros are replaced with a 011011 of the form OVBOVB, where V is a "1" violating the polarity of the last "1" and B is a "1" not violating the last "1". When shift register U3 has the pattern 010010, where the "1's" indicate bipolar violations and the data shift register U4 has the pattern 011011, both patterns are detected by gates U6A and C and U7. If U6B has been enabled by the inverted DS2 select line from U12E, both shift registers U3 and U4 will be cleared. This replaces the B6ZS pattern with a string of six zeros and prevents the two bipolar violations in the B6ZS pattern from being counted as true bipolar violations. The NON-B6ZS data from U4 is latched by J-K flip-flop U1B and output to the Modulo-2 Descrambler and off the card.

The data, which has been resynchronized by U1B, is delayed half a clock cycle by U18B and then fed to the Modulo-2 Descrambler consisting of U18A and U19A. If the Model 4654A Analyzer is operating in any mode other than FRAMED DS1C, flip-flop U18A is held cleared by U22A and B. This puts a zero on

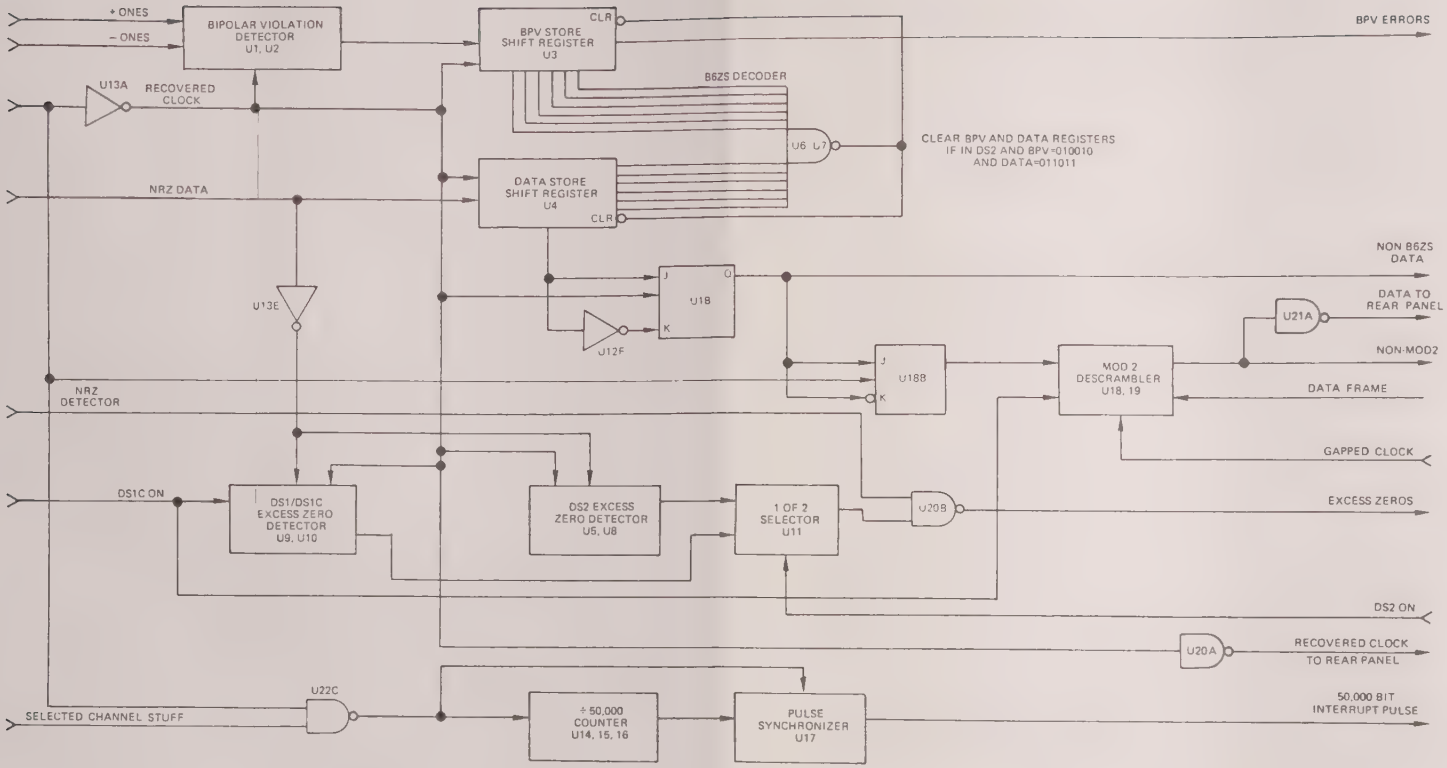


Figure 4.11. Decoder/Detector PCB (A9), Block Diagram

U18A's Q output and the data from U18B passes directly through U19A and off the card. In FRAMED DS1C mode, U18A is enabled and the current data bit is exclusive-ORed with the previous bit by U19A. The output of U19A is the Modulo-2 Descrambled DS1C data. The Modulo-2 Descrambler can be manually disabled by moving the jumper on J2, grounding the CLR input of U18A. This jumper must be returned to its original position for normal operation of the Modulo-2 Descrambler.

Excess zeros are strings of 16 or more zeros for DS1, 34 or more for DS1C, and 6 or more for DS2. DS1 and DS1C excess zeros are detected by U9 and U10. U9 and U10 form an 8-bit binary counter that is loaded 16 counts below terminal count for DS1 and 34 counts low for DS1C. The incoming data is inverted by U13E so that strings of zeros appear as strings of ones. If a string of 16 or 34 zeros appears in the data, U9 and U10 are allowed to count up to terminal count and the RCO of U10 goes high which indicates excess zeros and stops the counters by pulling the ENB-P of U9 low through U12C. These counters advance each time a zero occurs, but are reset 16 or 34 low whenever a "one" occurs in the data. The RCO of U10 is connected to the 1-of-2 selector formed by U11A, B and D. To detect excess zeros in DS2, the inverted data from U13E is loaded into shift register U5. If six zeros in a row occur, U5's outputs Q_0 to Q_5 will contain "ones" and this will be detected by U8. The output of U8 is inverted by U12D so that its excess zero indication will be the same polarity as the output from the DS1/1C detector. The output goes to the 1-of-2 selector U11A, B, D which is controlled by the DS2 select line. The Excess Zero Detector out is disabled by the NRZ Detect line when the unit operates in NRZ mode. This prevents the local printer from logging excess zeros when such measurement has no meaning.

The Decoder/Detector PCB also contains a divide-by-50,000 counter which provides bit interrupts to the microprocessor. The recovered clock is gapped when a stuff occurs in the selected channel by U22C. This clock is then fed to a divide-by-50,000 counter chain formed by U14, U15 and U16. U16 provides an output every 50,000 data bits minus stuffed bits. This output is synchronized and made one clock cycle wide by U17 and sent to the Interrupt Request flip-flop on the Error Counter PCB (A5). The Decoder/Detector PCB also con-

tains two 50-ohm line drivers, U20A and U21A, which supply the recovered clock and NON-B6ZS or NON-MOD-2 data to the BNC connectors on the rear panel.

D. FRAME SYNCHRONIZER PCB (A8)

A block diagram of the Frame Synchronizer PCB is shown in Figure 4.12. The schematic is shown in Figure 7.16. The primary functions of this PCB are: (1) detect and synchronize to the DS1C or DS2 F-bit and M-bit patterns, and (2) detect the occurrence of stuffing by checking the status of the C-bits and outputting a pulse when stuffing occurs in a particular channel. The card also contains a latch to catch the X-bit (M4), a driver to provide the M-SYNC pulse to the rear panel BNC connector, and a circuit to produce the "gapped" clock. This PCB is disabled when operating on DS1 or unframed DS1C or DS2.

The F-Frame signal is declared to be "In Sync" when 8 successive input F-bits match with a predicted pattern. The F-Frame signal is declared "Out-of-Sync" when 3 or more F-bit errors occur in a M-Frame. From the "Out-of-Sync" condition, flip-flop U1A detects the next data 1, which causes U1A to switch so that its $\overline{Q}$ output is high. This allows Bit Counters U9 and U10 to start counting which, in turn, allows Frame Counter U11 to count. The Q_C output of U11 is the predicted F-bit pattern which is compared with the incoming data by U3A. Counter U8 begins the cycle loaded 8 counts below terminal count. For each F-bit match that occurs, U8 counts up one. If an F-bit error occurs before "In-Sync" is achieved, U8 is reloaded 8 counts low and flip-flop U1A is reset to look for the next data one and the cycle repeats. It is by this trial-and-error method that the F-Frame sequence is found. When 8 successive F-bit matches occur, the RCO of U8 goes high to indicate F-Frame sync. Framing Bit Counter U11 is now synchronized to the framing bit pattern and counts the six framing bits in each subframe. The three-bit output of U11 is decoded by 3-to-8 decoder U13 into six output clocks synchronized to the M-, F- and C-bit locations.

Once F-Frame Sync has been achieved, the circuit must synchronize to the M-bit pattern. The M-bits from the incoming data are loaded into the 4-bit shift register U18, by the M-bit clock from U13. The pattern searched for is

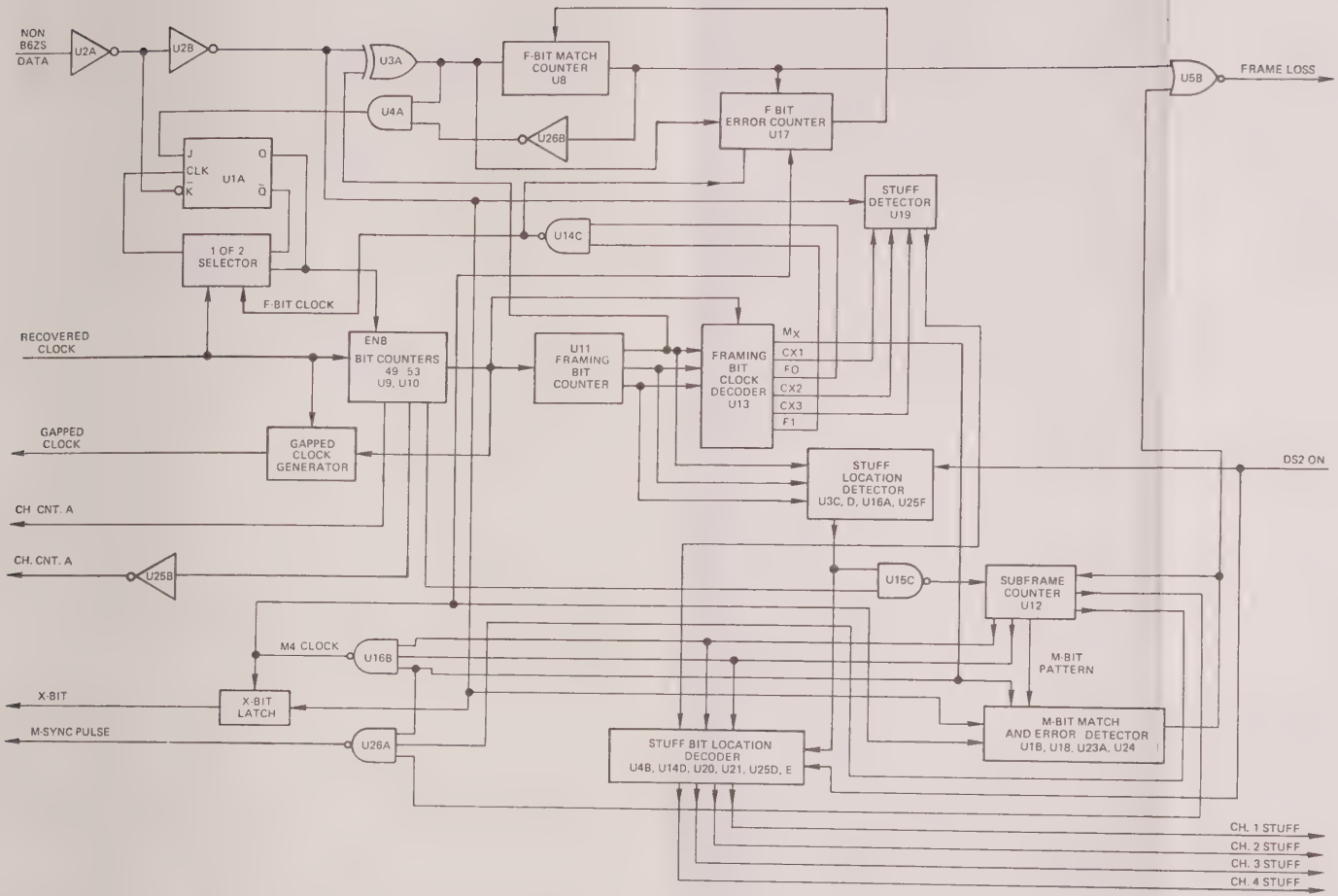


Figure 4.12. Frame Synchronizer PCB (A8), Block Diagram

M1, M2, M3, M4 = 011X where the X-bit can be a "0" or a "1". Gate U16C detects the 011 pattern in the 4th, 3rd and 2nd stages of U18. When this occurs, U16C enables flip-flop U1B to clock to the $\overline{Q}$ = 1 state which indicates M-Frame in sync. U1B releases Subframe Counter U12 to allow it to count the four subframes which form an M-Frame. U12 is clocked by the NANDed (U15C) output Q_B from bit counter U10 and the output from the stuff location detect circuits consisting of U3C, D, U16A and U25F. This assures that the subframe counter will not advance until after stuffing has occurred. The output of U12 is decoded by NAND gate U14B to generate the M-bit pattern which is compared to the incoming M-bits by U3B. U3B will output a "0" when the predicted and actual M-bits match. Gates U14A and U4D are used to force a match at the M4 (X-bit) location since this bit can be a "0" or a "1". This comparison is fed to the J input of flip-flop U23A which is clocked by the inverted M-bit clock from U13. U23A is cleared each M-Frame by the M4 clock decoded by U16B. When an M-bit match occurs, J of U23A is low and the flip-flop remains cleared, which applies a "1" to the S1 input of shift register U24 causing it to be cleared when clocked since it parallel loads all zeros. If an M-bit error occurs, U23A sets and applies a "0" to S1 of U24. This causes a "1" to be shifted to the Q_A output. If 3 successive M-Frames have M-bit errors, a "1" will appear on the Q_C output of U24. This is applied to the J input of U1B which causes it to set on the next M-bit clock. This clears subframe counter U12 and the circuit begins searching for M-Frame sync again. The outputs of M-Sync flip-flop U1B and F-Frame sync counter U8 are gated together by U5B to indicate to the microprocessor if either pattern loses synchronization.

The second major function of the Frame Synchronizer PCB, is to detect the occurrence of stuffing and to output a pulse when each data channel stuffs. A stuff is indicated by the C-bits in a certain subframe switching from "0's" to "1's". The C-bits are clocked into shift register U19 by the Cx1, Cx2 and Cx3 clocks from U13 which are gated together by U15B. If any two of the three C-bits in a subframe are "1's", the Q_B of U19 goes high indicating that a stuff is occurring. In DS2, channel 1 stuffs occur in the first subframe, channel 2 stuffs in the 2nd subframe, etc. In DS1C, channel 1 stuffs occur in the 1st and 3rd subframe, and channel 2 stuffs in the 2nd and 4th. The Q_B of U19 is input to the ENT of 4-bit counter U20. Outputs Q_A and Q_B from bit counter U9

are decoded by U14D and U25D and E, and fed to ENP of U20. U20 is loaded at each framing bit to 1110 for DS1C or 1111 for DS2. When U20 reaches terminal count, its RCO enables 2 to 4 line decoder U21B which is controlled by the Q_A and Q_B outputs of U9. U21B determines which bit in the data group between framing bits is being stuffed. The stuff location detect circuit (U3C and D, U16A, U25F) determines in which data group the stuff has occurred (stuffing occurs in the group prior to the F1 on DS1C and after the F1 bit on DS2), and enables decoder U21A which is controlled by the Q1 and Q2 outputs of subframe counter U12. Gate U4B allows U21A to only count 0, 1, 0, 1,... on DS1C which has only two channels, and to count 0, 1, 2, 3, 0, 1,... on DS2. When the outputs of U21A and B agree for a certain channel, the corresponding gate of U22 outputs a low pulse to indicate that that channel has stuffed.

Flip-flop U23B captures the X-bit (M4) for display on the front panel. The incoming data is applied to the J and K inputs of U23B so that it acts as a latch. U23B is clocked by the M4 clock and holds the status of the X-bit for the entire M-Frame. U26A decodes the M-Sync pulse for the M-Sync BNC connector on the analyzer's rear panel. A "gapped" clock, which is the recovered clock gapped at the framing bit locations, is produced by U5D, U6C and U25C. The RCO of U10, which occurs at each framing bit, is gated with the "In-Sync" line from U8. This disables the gapping circuit when the analyzer is operating on DS1 or unframed DS1C or DS2. The output of U6C is inverted and used to disable U5D at the framing bit locations to produce a gap in the recovered clock. The output of the gapped clock circuit is the recovered clock when the analyzer is operating on DS1 or unframed DS1C or DS2.

E. DS1 FRAMING PCB (A7)

A block diagram of the DS1 Framing PCB is shown in Figure 4.13. The schematic is shown in Figure 7.14. The functions of this PCB are: (1) detect and synchronize to the DS1 framing bit pattern, and (2) generate a gapped clock to run the circuits on the Bit Error Detector PCB (A6).

All of the circuitry required to detect and synchronize to the DS1 framing bit pattern is contained in U1, a T-1 Serial Receiver IC. The circuitry

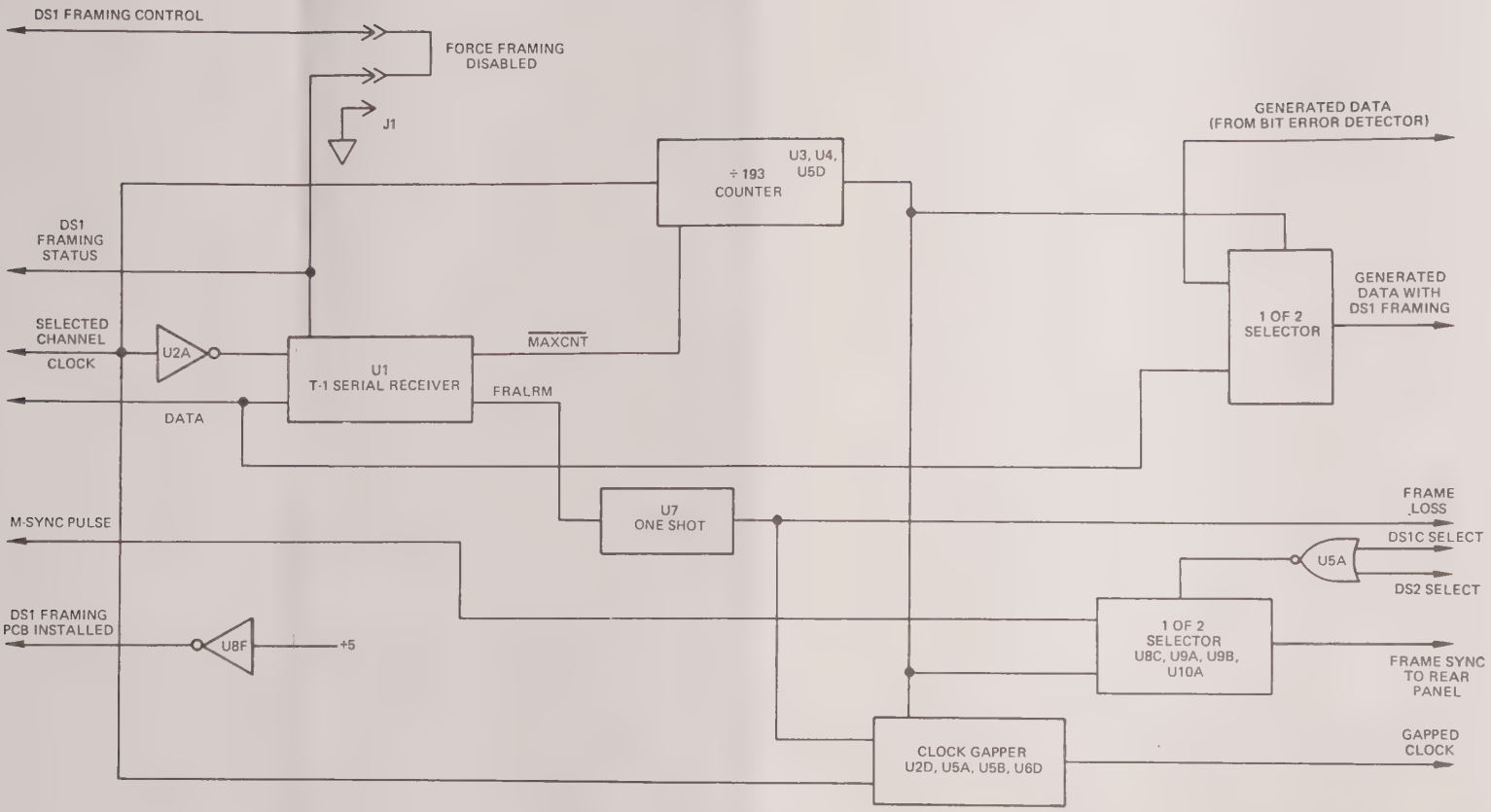


Figure 4.13. DS1 Framing PCB (A7), Block Diagram

on this PCB is clocked by the Selected Channel Clock, which is generated on the Bit Error Detector PCB. This allows the DS1 Framing circuitry to synchronize to either DS1 channel in a DS1C or any of the four DS1s in a DS2 signal. The operation of the DS1 framing circuit can be controlled by the microprocessor or manually controlled. If jumper P2 on J1 is on pins 1 and 2, the microprocessor controls the circuit and if P2 is on pins 2 and 3, the circuit is forced disabled. A line from U1-11 allows the microprocessor to determine if the DS1 Framing circuit is forced disabled. The line from U8-12 indicates to the microprocessor that the DS1 Framing PCB is installed in the unit.

When the DS1 signal is framed, the circuits on the Bit Error Detector PCB must be run by a clock gapped at the DS1 framing bit locations to prevent loss of synchronization of the generated data pattern to the incoming data pattern. The DS1 Framing PCB generates this gapped clock. The T-1 Serial Transmitter (U1) produces a pulse ($\overline{\text{MAXCNT}}$) every 386 clock cycles that is synchronized to the F-bit locations (see Figure 4.1). This pulse is used to synchronize a divide-by-193 counter consisting of U3, U4, and U5D. This counter produces a pulse every 193 bits that is used by U2D, U5B, and U6D to produce the gapped clock. This pulse is also used to control a 1-of-2 selector consisting of U2C, U6A, U6B, and U6C. This selector switches for one data period when a DS1 framing bit occurs. This allows the 4-bit shift register U23 on the Bit Error Detector PCB (A6) load the current DS1 Framing bit. This prevents bit errors from occurring in channels 2, 3, and 4 when both DS1C or all four DS2 channels and being monitored simultaneously. The pulse from the $\div$ 193 counter is output to the rear panel FRAME sync BNC when the unit is operating in DS1.

U1 produces a signal to indicate whether it has acquired frame lock (FRALRM). This line is low when U1 is locked onto the framing pattern and goes high when frame lock is lost. This signal is stretched by U7 and is used to control the clock gapping circuit and to indicate to the microprocessor the DS1 framing status.

F. BIT ERROR DETECTOR PCB (A6)

A block diagram of the Bit Error Detector PCB is shown in Figure 4.14. The schematic is shown in Figure 7.12. The primary functions of this card are: (1) synchronize to the incoming data pattern, (2) detect bit errors in the incoming data, and (3) destuff the data in each channel for DS1C and DS2. This PCB also contains the ALL ONES data detector and provides the Pseudo-Random Sync pulse to the rear panel BNC connector.

The data synchronization circuit consists of a 16/20 stage shift register made from U3, U4 and U5. For the PRBS pattern, all 20 stages are used with the input to the first stage the Exclusive-ORed (U6A) output of the 17th and 20th stages. For the other data patterns, only the first 16 stages are used and the output of the 16th is fed directly to the input of the first. Whether operation is PRBS or OTHER data is selected by a 1 of 2 selector consisting of U1A, U2A and U2B. The incoming data, which has been Modulo-2 descrambled for DS1C or B6ZS decoded for DS2, is loaded into the shift register via a 1-of-2 selector (U1C, U2C, U2D) which is controlled by the "In-Sync" detector. In the case of framed DS1C or DS2, only one channel's data is loaded into the shift register. The channel loaded is the channel selected by the Front Panel Channel Select button or channel one's data in the case of both DS1C channels or all four DS2 channels being selected. Loading a specific channel's data is done by clocking the shift register with the selected channel's clock which is produced by the channel clock generator (U6D, U10A, U17, U21D, U26B, U27B, and U27D). The Q_A and Q_B outputs of the bit counter (U9) on the Frame Syncronizer PCB (A8), is decoded (U6D, U10A, U21D, U27D) and fed into the A and B select inputs of 2-to-4 line decoder U17. The inverted, gapped clock is input to the Enable of U17. The gates associated with U17 also insure that only a two-channel clock is produced for DS1C, a four-channel clock for DS2, and that the clock output is on channel 1 if framing is lost. The channel clock desired is selected by the microcomputer via 4-line to 1-line selector U18A and output to U19D which gaps it when the selected channel stuffs. The stuff pulse which gaps the clock, is selected by U18B which is controlled by the same lines as U18A. If the unit is operated with framed DS1, the selected channel's clock is gapped at the DS1 framing bit locations by the DS1 Framing PWB (A7).

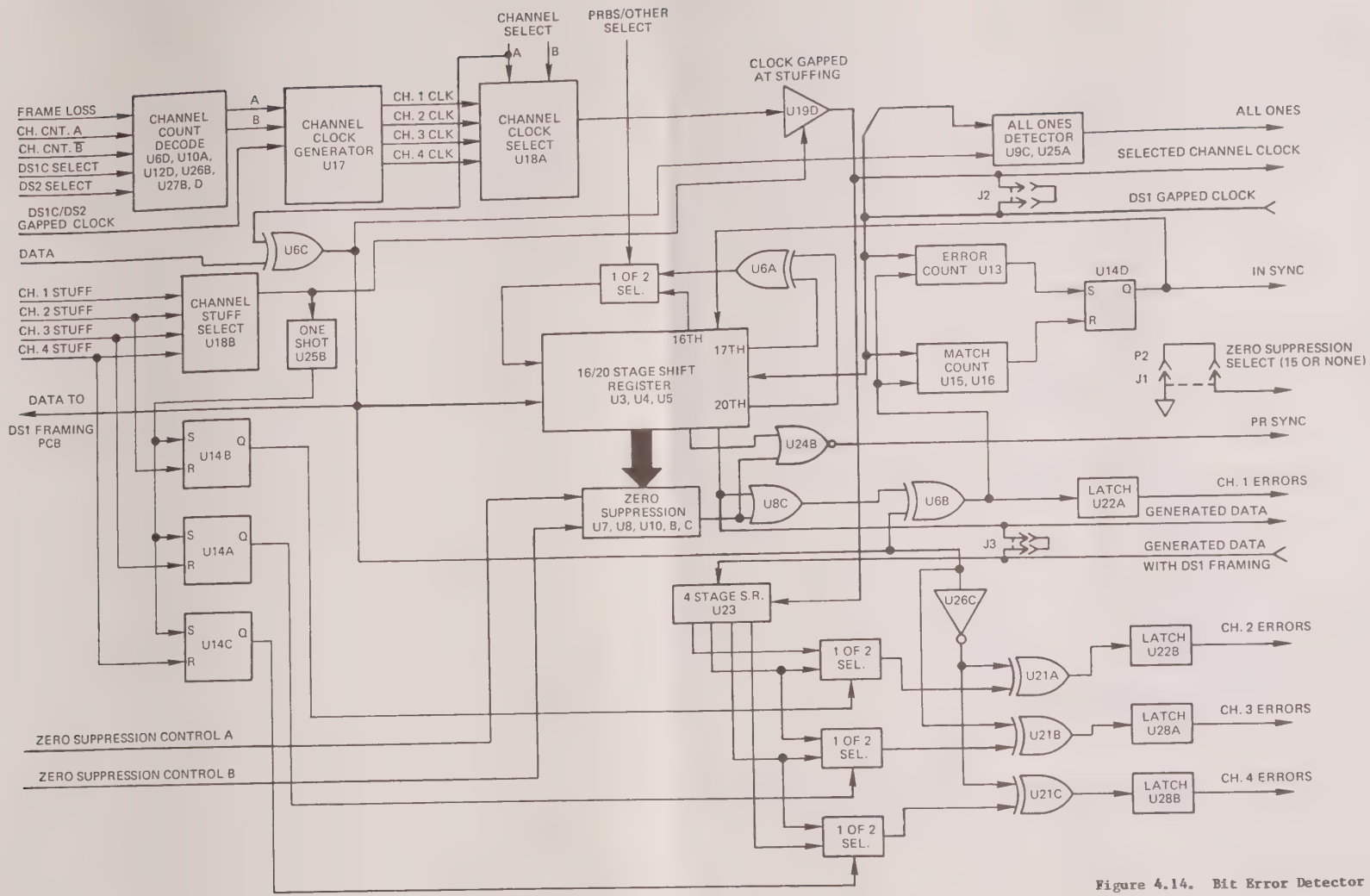


Figure 4.14. Bit Error Detector PCB (A6), Block Diagram

If channel 1 or 3 is selected, pin 9 of U6C is low and the data passes right through. If channel 2 or 4 is selected, U6C inverts the data since channels 2 and 4 are inverted versions of channel 1. The data in the 16/20 stage shift register is compared with the incoming data by U6B which outputs a low for a match and a high for an error. For an "In-Sync" condition to be declared, 20 consecutive matches must occur. Once in sync, 16 errors in 128 bits are required for the circuit to go out-of-sync again. When an error occurs, error counter U13 is incremented and match counter U15 and U16 are reloaded 20 below terminal count. When a match occurs, U13 is inhibited from counting and U15-16 counts up by one. When 20 consecutive matches occur, the match counter reaches terminal count and the RCO of U16 goes high. This is inverted by U26D and resets R-S flip-flop U14D, whose Q output goes low. This indicates to the microcomputer that data sync has occurred and also switches the 1-of-2 selector (U1C, U2C, U2D) so that the data in the 16/20 stage shift register is recirculated rather than loading new data. If 16 errors occur in 128 bits, the RCO of U13 goes high and this sets U14D to indicate out-of-sync and causes the loading of new data into the 16/20 stage shift register. Errors in channel one (or whichever channel is the selected channel) are latched by U22A and output to the Error Counter PCB (A5).

Gates U7, U8A, U8B, U10B, U10C, and selector U31 form a zero suppression circuit. If the DS1 is framed, 14 zero suppression occurs and if the DS1 is unframed, 15 zero suppression occurs. If the DS1C or DS2 is unframed, either 15 zero of no suppression can be selected by jumper P2. Jumper installed is No suppression. If 15 zeros occur, the output of U10C will be high and cause a data "one" to be output in the PRBS data pattern. When operating in other than the PRBS mode, the zero suppression circuit is disabled by pulling pin 5 of U8 high since a "one" and 15 zeros is a valid data pattern (MIN DENSITY). This jumper must be replaced on 1 and 2 for normal operations.

Data from the 16/20 stage shift register is loaded into a 4-stage shift register U23, where it is delayed 1, 2, or 3 bits for comparison of the channel 2, 3, and 4 data. The outputs of this shift register pass through three, 1-of-2 selectors used to destuff (described in the next paragraph) and on to the exclusive-OR gates U21A, B, and C where it is compared with the incoming

data. Since channels 2 and 4 are inverted, the incoming data going to U21A and C is inverted by U26C. An error causes the output of the exclusive-OR gate to go high and the error is latched by the corresponding flip-flop U22B, U28A, or U28B. The latches for each channel are cleared when the next channel is clocked to prevent errors from overlapping when added together on the Error Counter PCB (A5) and thus not being counted. The channel 2 latch is cleared by both channel 1 and channel 4 clocks to assure proper operation in both DS1C and DS2.

In DS1C and DS2, a bit in each channel is occasionally repeated or stuffed. To maintain synchronization, the data must be destuffed before error measurements are made. The occurrence of a stuff is detected by circuits on the Frame Synchronizer PCB (A8) and has already been described. The channel stuff pulses from these circuits are fed to the Bit Error Detector PCB where they are used to destuff the data. The selected channel stuff pulse or the channel 1 pulse (if all channels are being monitored), is selected by U18B and used to gap the clock via U19D to prevent the stuffed bit from being compared to the data in the 16/20 stage shift register. If both DS1C channels or all DS2 channels are being measured, the channel 1 stuff pulse also triggers one-shot U25B which sets flip-flops U14A, B, and C. When these flip-flops set, they switch the 1-of-2 selectors (U19A-U20B, U19B-U20C, and U19C-U20D) so that the data taken from the 4-stage shift register (U23) is moved back one stage. As channels 2, 3, and 4 stuff, the flip-flops are in turn reset which switches each 1-of-2 selector back in turn so that the channel's data is again taken from the normal stage of the shift register. When a specific channel destuffs, the clocking of that channel's error latch (U22 & U28) is inhibited by U29B, C, or D, or U19D for channel 1, to prevent errors from being counted during a destuff.

Retriggerable one-shot U25A is used as an all-ones data detector. If the incoming data is all ones, U25A will never be triggered and its output will be low, indicating all ones. However, if a zero occurs in the data, U25A will be triggered and its output goes high. The output of U25A is fed to the Error Counter PCB (A5), where it can be read by the microprocessor. The Bit Error Detector PCB (AC), also contains the circuitry to generate the Pseudo-Random

(PR) Sync Pulse to the rear panel BNC connector. It occurs once during each PRBS sequence of 1,048,575 bits when the first stage of the 20-stage shift register contains a "one" and the rest zeros. It is detected by gating together (U24B) the output of the 15-zero suppression circuit, the inverted (U1B) output of the lst stage and the outputs of the last five stages (U9A & B). The pulse is synchronized to the clock and output to the rear panel by 50-ohm driver U24A.

G. ERROR COUNTER PCB (A5)

A block diagram of the Error Counter PCB is shown in Figure 4.15. The schematic is shown in Figure 7.10. The Error Counter PCB has two main functions: (1) to count bit errors and bipolar violations and (2) to interface the microcomputer with the PCBs not on the micro-bus.

Both the bit and bipolar violation counters are 16-bit synchronous counters consisting of four 74LS693 4-bit counters with output registers and 3-state outputs. The four channel error lines from the Bit Error Detector PCB (A6) are input to a 1-of-8 selector, U20. Channels 1 and 2 are added by U11A and input to the selector for DS1C and these are added to channels 3 and 4 by U11B, and D for DS2. If a single channel is being measured, its errors come in on the channel 1 line into D0 of U20, regardless of which channel is being measured. If both DS1C channels are being measured, the errors go into D4 and errors from all four DS2 channels go into D5 of U20. The microcomputer selects which line will be output to the bit error counter by select lines A, B, and C of U20. The output of U20 goes to the Counter Clock inputs of U1, U2, U3 and U4 and causes the counter to increment with each error. The bipolar violation counter operates in a similar way except the errors are fed directly to the counters. When 50,000 bits are counted by the divider on the Decoder/Detector PCB (A9), flip-flop U14C is set which requests an interrupt from the microcomputer via transistor Q1 and also latches the error count into the internal registers of U1-U8. The microcomputer then has time to read the count while the counters can continue counting errors. The microcomputer then determines the number of errors that occurred between interrupts by subtracting the previous value from the current value.

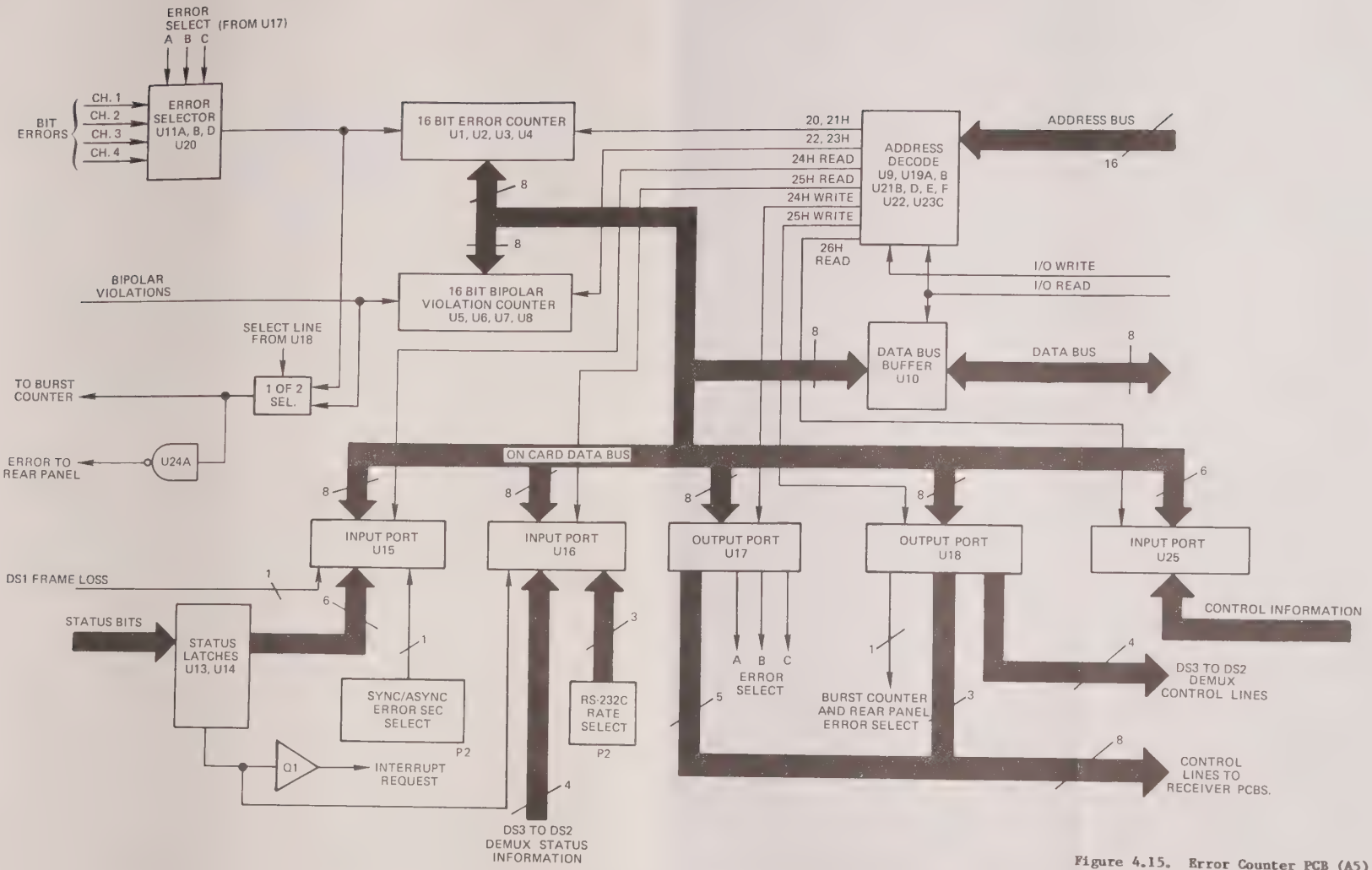


Figure 4.15. Error Counter PCB (A5), Block Diagram

The Error Counter PCB also contains the interface circuitry that allows the microcomputer to control the Model 4654A Analyzer. U9, U21, and U22 makeup the address decoder. The LSB and MSB of the bit and bipolar violation counters are at 20H through 23H respectively. The input ports U15 and U16 are located at read addresses 24H and 25H, and the output ports U17 and U18 are located at write addresses 24H and 25H. Input port U25 is located at read address 26H. U10 is a bi-directional bus driver that interfaces the microprocessor data bus to the on-card data bus. U13 and U14 are latches for capturing status information from the various PCBs. This information is transferred to the D-type flip-flops of U15 when a 50,000 bit interrupt occurs. The R-S latches are then immediately reset by U14D and U24B so that a status condition will not be lost if it recurs before U15 is read. U16 inputs RS-232C baud rate settings from J1 and status information from the optional Model 4656 DS3 to DS2 Demultiplexer when it is being remote controlled by the Model 4654A Analyzer. U17 sends control information to the various PCBs in the Model 4654A Analyzer. U18 sends additional control information to the analyzer PCBs and also outputs information to remote control the Model 4656 DS3 to DS2 Demultiplexer.

U23A, B, and D and U12C form a 1-of-2 selector controlled by the microcomputer which selects either bit errors or bipolar violations to be sent to the Burst Counter on the Real-Time Clock PCB (A2). The selected errors are also output to the rear panel ERROR BNC connector by 50-ohm driver U24A.

H. EXTERNAL EVENT MONITOR/MEMORY PCB (A4)

A block diagram of the External Event Monitor/Memory PCB is shown in Figure 4.16. The schematic is shown in Figure 7.8. Since this assembly contains two separate circuits (with only address decoding and data bus being common), this discussion will be divided into two sections.

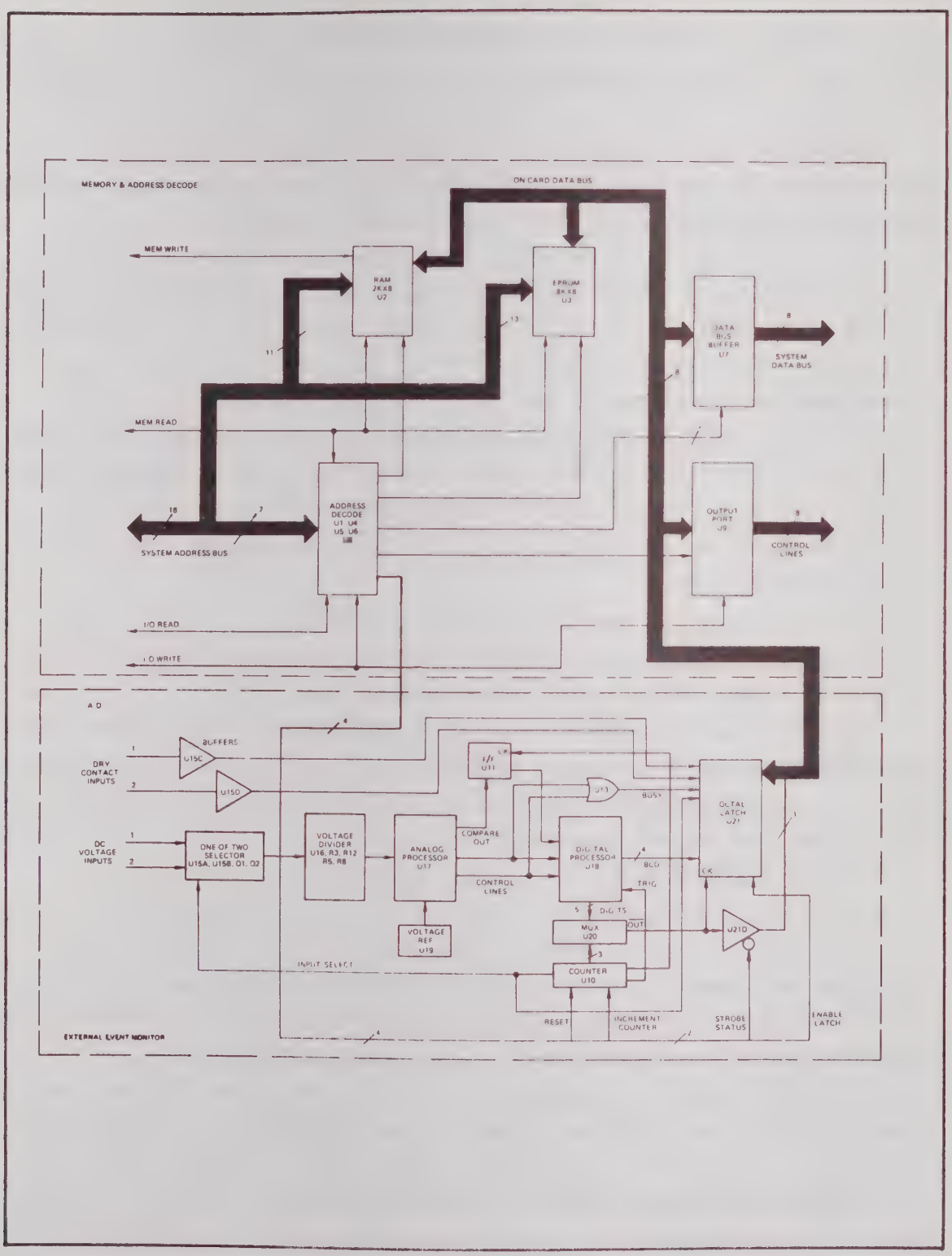


Figure 4.16. External Event Monitor/Memory PCB (A4), Block Diagram

1. Memory and Address Decoding (304123)
(Standard Equipment on 4654A)

This board has provisions for 8K of EPROM and 2K of RAM. U2 is a 6116 CMOS static RAM and U3 is a 2764 EPROM. The RAM is located at address DØØØH to D7FFH. The EPROM is located at address 8ØØØH to 9FFFH.

U1 decodes addresses to the 8K level. Output 4 (8ØØØ-9FFFH) is connected to the CE of EPROM U3. Output 6 (CØØØ-DFFFH) enables U5A which decodes to the 2K level. Output Ø of U5A (CØØØ-C7FFH) is gated with I/O Read to enable U5A which decodes the addresses for controlling the External Event Monitor (CØ-C7H). Output 1 of U5A is gated with I/O Write to enable U8A, which enables the output port U9 (C8 or CCH). U9 is an 8-bit output port, however only bits Ø and 1 are used. Output 2 of U5 (D8ØØ-DFFFH) enables the RAM. Output 3 of U5 (D8ØØ-DFFFH) is not used because this is where the RAM on the Real Time Clock PCB is located.

2. External Event Monitor Circuits (Optional) (304210)

The External Event Monitor circuit accepts two DC VOLTAGE inputs and two DRY CONTACT inputs, and operates at a 409 KHz clock rate. Its output consists of four bits to identify the BCD (binary coded decimal) value of the selected digit plus four control bits which are put onto the data bus. The schematic is shown in Figure 7.64.

The counter (U10) controls the sequencing of this circuit. Pins 5, 6, and 7 provide a count from 0 to 4 to the multiplexer (U20) thus selecting digits 1 through 5 to be input sequentially by the Digital Processor (U18). When the fifth digit is selected, pin 3 of U10 (INPUT SELECT) toggles. This causes U15A and U15B to turn on either Q1 or Q2. Thus the Digital Processor outputs first the BCD value of digits 1 through 5 for one input and then the other.

The selected input voltage is divided by the ratio of R19 to R3 +R12 (or R5 + R8), and limited by CR1 and CR2 (or CR3 and CR4). U19 provides a stable reference voltage for U17 (nominal 3.00V) by R22. This reference voltage pro-

vides U17's internal comparator with a half scale voltage reference point. Component U11 is arranged to form a D flip-flop clocked by the counter U10 so that the COMP OUT data of U17 will be clocked into the COMP IN input of U18 at the same rate at which the DC INPUTS are selected. The two control lines (A and B), when ORed together by U13, provide an indication to the microprocessor that U17 and U18 are BUSY. U18 is triggered each time a new digit is selected by U10 pin 7. Therefore, a new four-bit BCD value is output to the microprocessor, through latch U21, for each of the five digits of each of the two input voltages.

The two dry contact inputs are buffered and converted to TTL levels by U15C and U15D and sent to the microprocessor through latch U21 each time a new BCD value is output.

I. 8080 PROCESSOR PCB (A1)

The schematic of the Model 4654A Analyzer 8080 Processor printed circuit board (A1), is shown in Figure 7.4. With all the interactive components and interrelated circuits, the printed circuit board is the Central Processing Unit (CPU) of the Microcomputer circuits. The circuitry is arranged for on-board RAM at addresses E000H to E7FFH and for on-board ROM at addresses 0000 to 3FFFH. Ports of significant interest are listed below:

- o Output Port E1H is used to drive the local printer data bus.
- o Output Port E2H provides handshake interfacing to the local printer.

1. Model 4654A Analyzer 8080 Processor PCB General Description

A block diagram of the 8080 Processor (hereafter referred to as the Model 4654A Analyzer CPU) printed circuit board, is shown in Figure 4.17. The Model 4654A Analyzer CPU printed circuit board is designed to meet microcomputer applications from the single board stand-alone application to the multiboard small system uses. This is achieved by providing on-board RAM and ROM capability and 24 pins of programmable I/O matched to system expansion capability through a bus connector. The microprocessor circuitry consists of three inte-

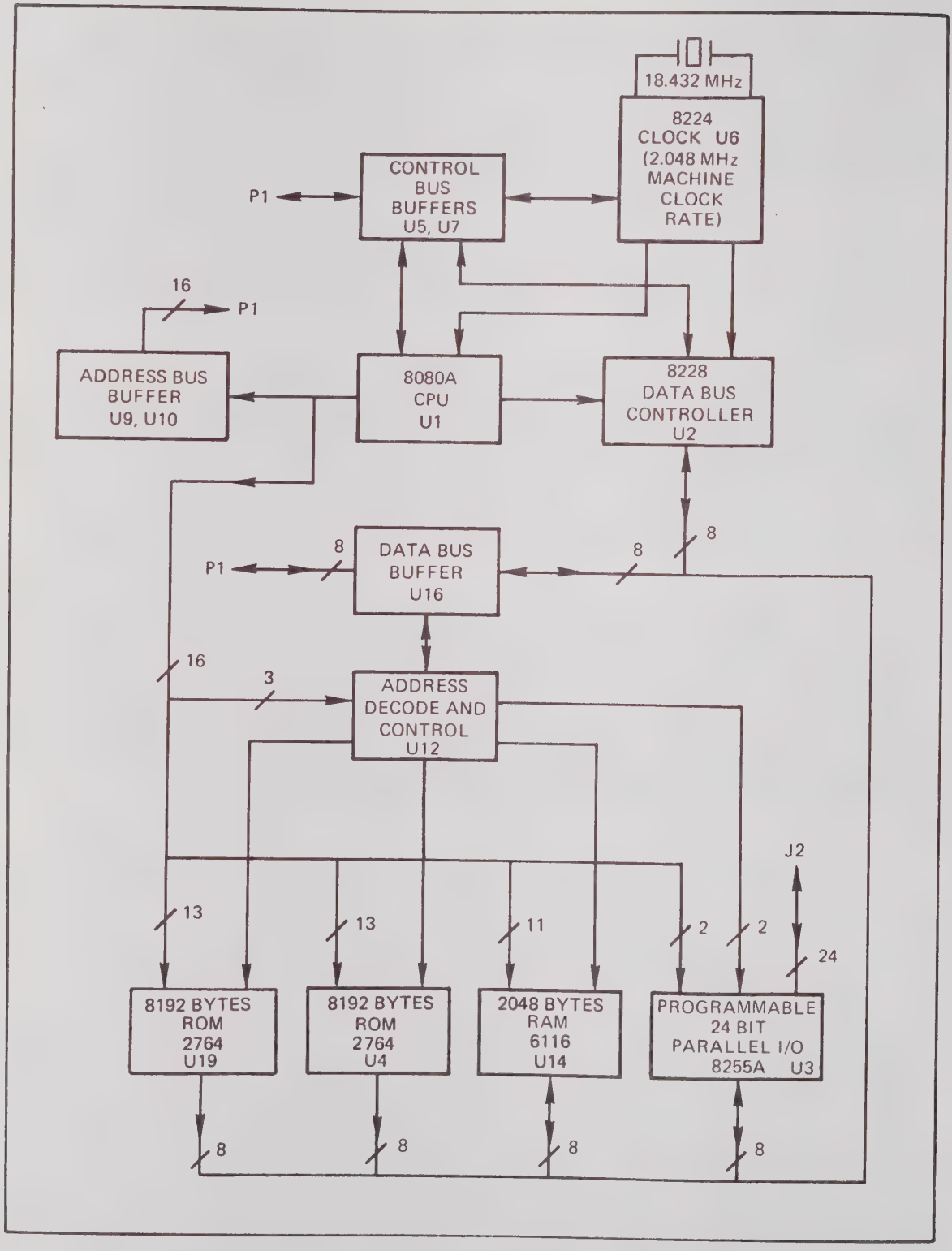


Figure 4.17. 8080 Processor PCB (A1), Block Diagram

grated circuit chips which include the 8080A Microprocessor, an 8224 clock generator, and an 8238 (or 8228) system controller. On-board decoders select appropriate RAM, ROM and I/O ports from the address bus and generate address, data, and control busses which are buffered and then output to the system bus connector.

The on-board ROM memory consists of two 2764 ICs which provide 16K bytes. The on-board RAM memory consists of one 6116-type IC to provide 2K bytes. On-board memory address decoding is done to the 8K address block level. The ROM socket number 1 uses addresses 0000 to 1FFF; ROM socket number 2 uses addresses 2000 to 3FFF; and the RAM uses addresses E000 to E7FF. RAM decoding is not unique and 2K of RAM may be accessed from E000 to E7FF, E800 to EFFF, F000 to F7FF, or from F800 to FFFF.

The on-board I/O consists of one 8255 Programmable Peripheral Interface IC chip which provides 24 lines of programmable input or output. Ports A, B, C, and the Command Register are decoded for addresses E0, E1, E2, and E3, respectively. However, the addressing is not uniquely decoded and the addresses E0 through FF are reserved for on-board I/O.

Model 4654A Analyzer CPU Printed Circuit Board Specifications. Specifications applicable to the 8080 Microprocessor printed circuit board are as follows:

Microprocessor

8080A Integrated Circuit (IC) using an 8224 Clock Generator and an 8238 (or 8228) System Controller. The Clock frequency is 18.432 MHz and the arrangement provides one interrupt.

Memory

ROM (Read Only Memory) using two 2764 ICs for two 8K bytes. RAM (Random Access Memory) is a 6116 CMOS static RAM providing 2K bytes.

Power Requirements (as measured to Common)

+12V dc at 0.15 Amp (Max)

+5.0V dc at 1.33 Amp (Max)

-5.0V dc at 0.05 Amp (Max)

Input/Output (I/O)

One 8255A IC providing 24 lines of programmable I/O and interrupt available through a 50-pin connector mounted on the printed circuit board. The system bus is available through an 86-pin board edge connector.

Mating Connector and Pinout Charts. The microprocessor I/O is provided through a 50-pin female connector which mates to a 50-pin male connector using a 50-conductor flat cable. Table 4.1 lists the 50 I/O pinouts.

Table 4.1
8080 Processor PCB (A1), I/O Port Pinouts and Functions

PIN	SIGNAL	PIN	SIGNAL	PIN	SIGNAL
3	PCØ	19	PBØ	35	PAØ
5	PC1	21	PB1	37	PA1
7	PC2	23	PB2	39	PA2
9	PC3	25	PB3	41	PA3
11	PC4	27	PB4	43	PA4
13	PC5	29	PB5	45	PA5
15	PC6	31	PB6	47	PA6
17	PC7	33	PB7	49	PA7
			1 & 2	+5.0V DC	

All even number pins (4 through 50) are Common (or Ground).

The system signaling is output through an 86-pin board edge connector located on the bottom of the printed circuit board. Bus pinouts and functions are shown in Table 4.2.

Table 4.2
8080 Processor PCB (A1), System Bus Pinouts and Functions

Component Side		Back Side		Component Side		Back Side	
Pin	Signal	Pin	Signal	Pin	Signal	Pin	Signal
1	-12	A	-12	23	----	a	READY
2	+12	B	+12	24	IOR	b	MEMR
3	+5	C	+5	25	INTA	c	02 CLK
4	+5	D	+5	26	IOW	d	MEMW
5	COM	E	COM	27	----	e	----
6	COM	F	COM	28	----	f	----
7	COM	H	COM	29	----	h	----
8	-5	J	-5	30	----	j	----
9	AB0	K	AB1	31	----	k	----
10	AB2	L	AB3	32	INTO	l	I1
11	AB4	M	AB5	33	I2	m	I3
12	AB6	N	AB7	34	I4	n	I5
13	AB8	P	AB9	35	I6	p	I7
14	AB10	R	AB11	36	I8	r	I9
15	AB12	S	AB13	37	I10	s	I11
16	AB14	T	AB15	38	I12	t	I13
17	----	U	----	39	I14	u	I15
18	OSC	V	INT	40	DB0	v	DB1
19	BUSEN	W	RESET	41	DB2	w	DB3
20	WAIT	X	HLDA	42	DB4	x	DB5
21	INTE	Y	RES	43	DB6	y	DB7
22	HOLD	Z	SYNC				

2. 8080 Processor PCB Detailed Circuit Description

General. This detailed circuit description does not include the internal operation of the 8080A Microprocessor or the peripherals. These functions are presumed to be known for explanation of other circuitry on the printed circuit board. For those who need more information, the 8080 Microprocessor is well documented in Application Notes and User Manuals. The 8080 Microprocessor is arranged in this group of circuits in the standard configuration. The primary advantage of the 8080 Microprocessor is having a simple, fixed hardware design. This leaves the bulk of Application Design in the software where corrections, modifications, and updates are easily accomplished. The following descriptions use the positive true logic levels where a Logic "0" is equal to approximately 0 volts (<0.8V dc) and a Logic "1" is equal to approximately +5.0V dc (>2.4V dc).

Microprocessor Component Group. The standard three-chip configuration of the 8080 Microprocessor consists of the 8080 IC (U1), 8238 (or 8228) IC (U2) System Controller, and an 8224 IC (U6) Clock Generator. These three IC's are interconnected in the manufacturer's recommended configurations and operate as the "brains" of the printed circuit board.

The Clock Generator (U6) produces the different timing signals necessary for operation of the 8080 Microprocessor (U1) based on the frequency of the crystal, Y1. The recommended crystal frequency of 18.432 MHz generates Ø1 and Ø2 frequencies at 2.048 MHz to cycle the 8080 Microprocessor circuits in 488 nanoseconds. The Ø2 Clock signal is output to the bus connector at 2.048 MHz, which is easily divided down to standard reference frequencies for the Serial I/O Port and other uses. The crystal frequency, 18.432 MHz, is also output to the bus connector for use with other circuits.

The remaining signals in the Address Bus, the Data Bus, and the Control Bus will be described as they are used with other circuits.

Address Bus Buffers. Circuit chips designated U9 and U10, buffer the address bus onto the system bus connector for use by the expansion printed

circuit boards. Each chip is actually a 3-state output transparent latch with its 3-state output control wired through U7 to the BUSEN signals.

The ICs used for U9 and U10 (74LS373) can each sink 24 milliamperes of current to provide adequate buffering for a heavily loaded system application. Note also that address decoding internal to the printed circuit board uses the unbuffered lines.

Data Bus Buffers. The component designated U16 provides bidirectional data bus buffering between the circuitry of U2 and the system data bus. Data flows into or out of the printed circuit board with the buffer direction (U16, pin 1) controlled by U11. The Data Bus Buffer (U16) always outputs data onto the bus except during Memory Read (MEMR), Input/Output Read (IOR), or Interrupt Acknowledge (INTA). These three signals are logic "ORed" to reverse operation of U16 to input data from the bus into the 8228 circuits whenever any are active.

The chip select line of U16 (pin 19) switches the 3-state inputs and outputs between the low impedance operate state to the high impedance off state. The circuitry provided with U13 drives the chip select function of U16 and also puts U16 into the high impedance (off state) whenever on-board RAM, ROM, or I/O is selected or BUSEN is low. This feature avoids on-board memory or I/O driving the on-board data bus simultaneously against U16 during on-board memory or I/O reads.

Random Access Memory (RAM). The RAM consists of a 6116 CMOS static RAM (2K x 8), providing 2048 bytes of usable memory. Eleven lines of the address bus connect to the RAM address to select a particular location and chip select for memory control of data transfer between the CPU and the RAM. The Memory Write (MEMW) is output from the 8238 chip (U2, pin 26) which is low during memory write instructions and high at all other times.

The Memory Write function strobes data bus into the RAM when low and puts RAM data onto the data bus when high. The RAM select is decoded by U12 and can be jumper selected to place the RAM in any 8K block not occupied by the

onboard EPROMs. In the Model 4654A Analyzer, the RAM is placed in the highest 8K block (E000 to FFFF).

Read Only Memory (ROM). Two 28-pin sockets, designated U4 and U19, are provided for on-board storage using two 2764 EPROMs. Both sockets will accept 2764 or 2732 type EPROMs.

The address bus lines A0 through A12 are wired directly to the U4 and U19 sockets. Chip select decoding is provided by U12. The ROM 1 (U4) will be selected whenever addresses AB15, AB14, and AB13 are low, which correspond to addresses 0000 to 1FFF. The ROM 2 (U19) will be selected when AB15 and AB14 are low and AB13 is high, which corresponds to addresses 2000 to 3FFF. The ROM outputs are 3-state, and whenever chip select is enabled, the contents of the addressed location are output onto the data bus.

I/O Port. The I/O Port uses the circuitry of an 8255 IC (U3), which provides 24 lines of programmable input and output. These are available in three 8-bit bytes. The 8255 ports A, B, C, and Control are at Addresses E0, E1, E2, and E3, respectively, (as described in the I/O Map) with seven more redundant addresses through FF. Address bits A0 and A1 are input to the 8255 to select the internal registers, and half the circuits of IC-U13 decode the Address bus to drive the 8255-chip select function.

During the I/O Address mode, the Address bus duplicates the 8-bit I/O Address in the lower (A0 through A7) and upper (A8 through A15) address bits. The IOR and IOW outputs of IC 8238 (U2), are logic ORed by U11 to generate an I/O Enable signal which, in turn, is input to the quad NAND gate U13 (together with three Address lines, A5, A6, and A7) to generate the 8255 chip select function. Since A5, A6, and A7 must all be high (Logic level "1") to enable Chip Select, the 8255 Address must be higher than E0; and since A2, A3, and A4 are ignored, eight redundant I/O Addresses in the range E0 to FF will actually be decoded.

The Port A, Port B, and Port C outputs are wired to the top edge connector on the printed circuit board. The mating connector is attached to a flat

cable and to provide signal isolation, alternate pins of the connectors are grounded. Since Port C provides handshaking for Port A and Port B in Mode 1 and Mode 2 of the 8255 circuit, two pins of Port C are wired to terminals E16 and E17 to provide I/O Interrupt capability. When terminal E16 is jumpered to terminal E15, the Interrupt function is provided to Port B; and similarly, terminal E17 jumpered to terminal E15 provides Interrupt function for Port A. More information is provided in the References. See the 8255 description for Programming Assignments.

Miscellaneous Circuitry. The Wait output is buffered and output from the printed circuit board. The Ready input is also available on the system bus connector. The signals Interrupt Enable (INTE), Reset, Sync, and Hold Acknowledge (HLDA) are also buffered and output on the system bus connector. Input signals to the printed circuit board, such as Interrupt (INT), Hold, and Bus Enable (BUSEN), are also buffered. Other control bus signals, such as IOR, IOW, MEMR, MEMW, etc. are wired directly to and from the 8080 Microprocessor circuits.

J. REAL-TIME CLOCK PCB (A2)

A block diagram of the Real-Time Clock PCB is shown in Figure 4.18. The schematic is shown in Figure 7.6. This card provides a timekeeping function to permit the various types of timed error measurement and to allow logging of these measurements versus time. Other functions on the board are (1) EPROMs for program storage, (2) a CMOS RAM for data storage, (3) counters and latches for Error Burst measurements, (4) a "dead-man" timer to permit recovery from soft errors and, (5) a rechargeable battery for backup of the clock and RAM functions when external power is removed.

The timebase for the real-time clock consists of a 32768 Hz crystal (Y1), a phase-shifting network (C2 and R12), a trimmer capacitor (C1), and a 4060 CMOS 14-stage binary counter. U1. the Real-Time Clock, is interfaced to the microprocessor bus through the data bus buffer (U14) and address decoding circuitry (U8B, and U15), and resides at port addreses 40H thru 5FH, except for

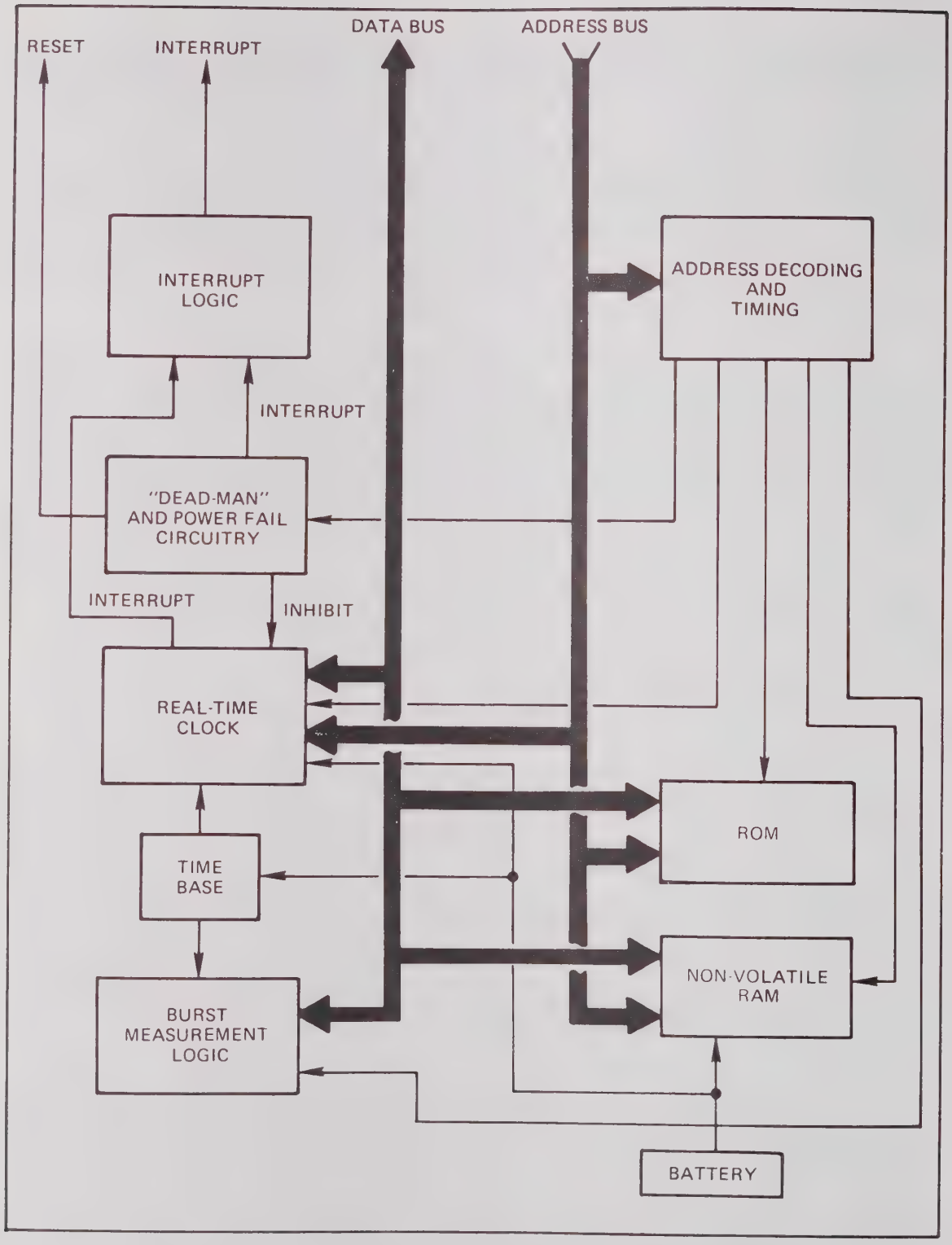


Figure 4.18. Real-Time Clock PCB (A2), Block Diagram

58, 59, 5A and 5B. Figure 4.19 (8 sheets) is a data sheet on this device, the MM58167A.

The EPROM sockets, U11 and U12, provide up to 16K bytes of program storage. They will accept Intel compatible 2732s or 2764s. Address decoding (U3A) is such that U11 resides at 4000H to 5FFFH and U12 at 6000H to 7FFFH. Jumper block J5, if installed, permits these addresses to be modified to other locations.

The non-volatile CMOS RAM consists of U9, a 6116 static CMOS RAM, with a total capacity of 2K bytes. Address decoding is performed by U3B, U7 and U8, in such a manner that the RAM appears at D800H to DFFFH. The non-volatile RAM is used to store front panel set-ups and operating data during a power-down.

The Error Burst measurement process is fairly complex and is mostly contained in U16, U17, U18, U20, U21 and U23. First, a 1024Hz (~1 millisecond) clock is acquired from the Real-Time Clock time base (U16). Q3 and U13B isolate the time base from the burst counter when power is off. The divider is provided with space for a jumper block (J3) which, if installed, allows a different tap to be selected. Two D-flip-flops (U21A and U21B) serve as a burst detector: U21A is set every millisecond and remains set in the absence of errors. At the beginning of the next millisecond, this state is transferred to U21B providing a record of whether the preceeding millisecond contained an error. Thus U21B remains clear for the duration of an error burst. U23B serves as an inverter to allow U18 to count the duration of each burst, up to a maximum of 125 milliseconds. At the end of an error burst, the rising edge on pin 9 of U21B, increments the burst counter (U17) and sets the burst interrupt flip-flop (U23A). If this was the first burst since the interrupt was last serviced, the burst length is transferred to the output latch, U20. The interrupt is serviced by writing to any port address in the range 58H to 5BH. The burst length counter may be read by the microprocessor via port 5AH or 5BH. The burst counter is also available in the bottom 3 bits of port 58H or 59H.

National Semiconductor

April 1982

MM58167A Microprocessor Real Time Clock

General Description

The MM58167A is a low threshold metal gate CMOS circuit that functions as a real time clock in bus oriented microprocessor systems. The device includes an addressable real time counter, 56 bits of RAM, and two interrupt outputs. A $\overline{\text{POWER DOWN}}$ input allows the chip to be disabled from the rest of the system for standby low power operation. The time base is a 32,768 Hz crystal oscillator.

Features

- Microprocessor compatible (8-bit data bus)
- 1/10,000 of a second through month counters
- 56 bits of RAM with comparator to compare the real time counter to the RAM data
- 2 INTERRUPT OUTPUTS with 8 possible interrupt signals
- $\overline{\text{POWER DOWN}}$ input that disables all inputs and outputs except for one of the interrupts
- Status bit to indicate rollover during a read
- 32,768 Hz crystal oscillator
- Four-year calendar (no leap year)
- 24-hour clock

Functional Description

Real Time Counter

The real time counter is divided into 4-bit digits with 2 digits being accessed during any read or write cycle. Each digit represents a BCD number and is defined in Table I. Any unused bits are held at a logical zero during a read and ignored during a write. An unused bit is any bit not necessary to provide a full BCD number. For example tens of hours cannot legally exceed the number 2, thus only 2 bits are necessary to define the tens of hours. The other 2 bits in the tens of hours digit are unused. The unused bits are designated in Table I as dashes.

The addressable portion of the counter is from 1/10,000 of a second to months. The counter itself is a ripple counter. The ripple delay is less than 60 μs above 4.0V and 300 μs at 2.0V.

RAM

56 bits of RAM are contained on-chip. These can be used for any necessary power down storage or as an alarm latch for comparison to the real time counter. The data in the RAM can be compared to the real time counter on a digit basis. The only digits that are not compared are the unit ten thousandths of seconds and tens of days of the week (these are unused in the real time counter). If the two most significant bits of any RAM digit are ones, then this RAM location will always compare.

The RAM is formatted the same as the real time counter, 4 bits per digit, 14 digits, however there are no unused bits. The unused bits in the real time counter will compare only to zeros in the RAM.

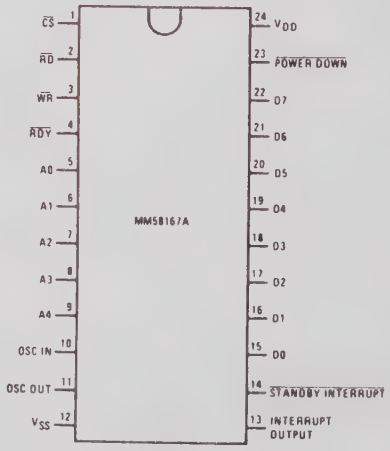
Interrupts and Comparator

There are two interrupt outputs. The first and most flexible is the INTERRUPT OUTPUT (a true high signal). This output can be programmed to provide 8 different output signals. They are: 10 Hz, 1 Hz, once per minute, once per hour, once a day, once a week, once a month, and when a RAM/real time counter comparison occurs. To enable the output a one is written into the interrupt control register at the bit location corresponding to the desired output frequency *(Figure 1)*. Once one or more bits have been set in the interrupt control register, the corresponding counter's rollover to its reset state will clock the interrupt status register and cause the interrupt output to go high. To reset the interrupt and to identify which frequency caused the interrupt, the interrupt status register is read. Reading this register places the contents of the status register on the data bus. The interrupting frequency will be identified by a one in the respective bit position. Removing the read will reset the interrupt.

The second interrupt is the $\overline{\text{STANDBY INTERRUPT}}$ (open drain output, active low). This interrupt occurs when enabled and when a RAM/real time counter comparison occurs. The $\overline{\text{STANDBY INTERRUPT}}$ is enabled by writing a one on the D0 line at address 16_H or disabled by writing a zero on the D0 line. This interrupt is not triggered by the edge of the compare signal, but rather by the level. Thus if the compare is enabled when the $\overline{\text{STANDBY INTERRUPT}}$ is enabled, the interrupt will turn on immediately.

Connection Diagram

Dual-In-Line Package



TOP VIEW

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Figure 4.19. Real-Time Clock IC, Data Sheet (Sheet 1 of 8)

Absolute Maximum Ratings

Voltage at All Pins	V_{SS} − 0.3V to V_{DD} + 0.3V
Operating Temperature	−40°C to 85°C
Storage Temperature	−65°C to 150°C
V_{DD}-V_{SS}	6.0V
Lead Temperature (Soldering, 10 seconds)	300°C

Electrical Characteristics V_{SS} = 0V, −40°C ≤ T_A ≤ 85°C

Parameter	Conditions	Min	Max	Units
Supply Voltage				
V_{DD}	Outputs Enabled	4.0	5.5	V
V_{DD}	$\overline{\text{POWER DOWN}}$ Mode	2.0	5.5	V
Supply Current				
I_{DD}, Static	Outputs TRI-STATE®			
	f_{IN} = DC, V_{DD} = 5.5V		10	μA
I_{DD}, Dynamic	Outputs TRI-STATE			
	f_{IN} = 32 kHz, V_{DD} = 5.5V			
	$V_{IH} \geq V_{DD} - 0.3V$			
	$V_{IL} \leq V_{SS} + 0.3V$		20	μA
I_{DD}, Dynamic	Outputs TRI-STATE			
	f_{IN} = 32 kHz, V_{DD} = 5.5V			
	V_{IH} = 2.0V, V_{IL} = 0.8V		5	mA
Input Voltage				
Logical Low		0.0	0.8	V
Logical High		2.0	V_{DD}	V
Input Leakage Current	$V_{SS} \leq V_{IN} \leq V_{DD}$	−1	1	μA
Output Impedance	I/O and INTERRUPT OUT			
Logical Low	V_{DD} = 4.5V, I_{OL} = 1.6 mA		0.4	V
Logical High	V_{DD} = 4.5V, I_{OH} = −400 μA	2.4		V
	I_{OH} = −10 μA	0.8 V_{DD}		V
TRI-STATE	$V_{SS} \leq V_{OUT} \leq V_{DD}$	−1	1	μA
Output Impedance	$\overline{\text{RDY}}$ and $\overline{\text{STANDBY}}$ $\overline{\text{INTERRUPT}}$			
Logical Low, Sink	V_{DD} = 4.5V, I_{OL} = 1.6 mA		0.4	V
Logical High, Leakage	$V_{OUT} \leq V_{DD}$		10	μA

Functional Description (Continued)

TABLE I. REAL TIME COUNTER FORMAT

Counter Addressed		Units D0	D1	D2	D3	Max BCD Code	Tens D4	D5	D6	D7	Max BCD Code
1/10,000 of Seconds	(00_H)	-	-	-	-	0	D4	D5	D6	D7	9
Hundredths and Tenths Sec	(01_H)	D0	D1	D2	D3	9	D4	D5	D6	D7	9
Seconds	(02_H)	D0	D1	D2	D3	9	D4	D5	D6	-	5
Minutes	(03_H)	D0	D1	D2	D3	9	D4	D5	D6	-	5
Hours	(04_H)	D0	D1	D2	D3	9	D4	D5	-	-	2
Day of the Week	(05_H)	D0	D1	D2	-	7	-	-	-	-	0
Day of the Month	(06_H)	D0	D1	D2	D3	9	D4	D5	-	-	3
Month	(07_H)	D0	D1	D2	D3	9	D4	-	-	-	1

(-) indicates unused bits

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Figure 4.19. Real-Time Clock IC, Data Sheet (Sheet 2 of 8)

Functional Description (Continued)

TABLE II. ADDRESS CODES AND FUNCTIONS

A4	A3	A2	A1	A0	Function
0	0	0	0	0	Counter—Ten Thousandths of Seconds
0	0	0	0	1	Counter—Hundredths and Tenths of Seconds
0	0	0	1	0	Counter—Seconds
0	0	0	1	1	Counter—Minutes
0	0	1	0	0	Counter—Hours
0	0	1	0	1	Counter—Day of Week
0	0	1	1	0	Counter—Day of Month
0	0	1	1	1	Counter—Month
0	1	0	0	0	RAM—Ten Thousandths of Seconds
0	1	0	0	1	RAM—Hundredths and Tenths of Seconds
0	1	0	1	0	RAM—Seconds
0	1	0	1	1	RAM—Minutes
0	1	1	0	0	RAM—Hours
0	1	1	0	1	RAM—Day of Week
0	1	1	1	0	RAM—Day of Month
0	1	1	1	1	RAM—Months
1	0	0	0	0	Interrupt Status Register
1	0	0	0	1	Interrupt Control Register
1	0	0	1	0	Counters Reset
1	0	0	1	1	RAM Reset
1	0	1	0	0	Status Bit
1	0	1	0	1	GO Command
1	0	1	1	0	$\overline{\text{STANDBY}}$ $\overline{\text{INTERRUPT}}$
1	1	1	1	1	Test Mode

All others unused

Figure 4.19. Real-Time Clock IC, Data Sheet (Sheet 3 of 8)

Functional Description (Continued)

The comparator is a cascaded exclusive NOR. Its output is latched 61 μs after the rising edge of the 1 kHz clock signal (input to the ten thousandths of seconds counter). This allows the counter to ripple through before looking at the comparator. For operation at less than 4.0V, the thousandths of seconds counter should not be included in a compare because of the possibility of having a ripple delay greater than 61 μs. (For output timing see Interrupt Timing.)

Power Down Mode

The $\overline{\text{POWER DOWN}}$ input is essentially a second chip select. It disables all inputs and outputs except for the STANDBY INTERRUPT. When this input is at a logical zero, the device will not respond to any external signals. It will, however, maintain timekeeping and turn on the $\overline{\text{STANDBY INTERRUPT}}$ if programmed to do so. (The programming must be done before the $\overline{\text{POWER DOWN}}$ input goes to a logical zero.) When switching V_{DD} to the standby or power down mode, the $\overline{\text{POWER DOWN}}$ input should go to a logical zero at least 1 μs before V_{DD} is switched. When switching V_{DD} all other inputs must remain between $V_{SS} - 0.3V$ and $V_{DD} + 0.3V$. When restoring V_{DD} to the normal operating mode, it is necessary to insure that all other inputs are at valid levels before switching the $\overline{\text{POWER DOWN}}$ input back to a logical one. These precautions are necessary to insure that no data is lost or altered when changing to or from the power down mode.

Counter and RAM Resets; GO Command

The counters and RAM can be reset by writing all 1's (FF) at address 12_H or 13_H respectively.

A write pulse at address 15_H will reset the thousandths, hundredths, tenths, units, and tens of seconds counters. This GO command is used for precise starting of the clock. The data on the data bus is ignored during the write. If the seconds counter is at a value greater than 40 when the GO is issued, the minute counter will increment; otherwise the minute counter is unaffected. This command is not necessary to start the clock, but merely a convenient way to start precisely at a given minute. (See Table III for reset format.)

Status Bit

The status bit is provided to inform the user that the clock is in the process of rolling over when a counter is read. The 1 kHz clock into the thousandths of seconds counter has a pulse width of 61 μs. If a read of the real time counter (any digits) is done during this 61 μs period the status bit will be set. This tells the user that the clock is rippling through the real time counter. Because the clock is rippling, invalid data may be read from the counter. If the status bit is set following a counter read, the counter should be reread.

The status bit appears on D0 when address 14_H is read. All the other data lines will be zero. The bit is set when a logical one appears. This bit should be read every time a counter read or series of counter reads are done. The trailing edge of the read at address 14_H will reset the status bit.

Oscillator

The oscillator used is the standard Pierce oscillator. Externally only 2 capacitors and the crystal are required. For micropower crystals a resistor in series with the oscillator output may be necessary to insure the crystal is not overdriven. This resistor should be approximately 200 kΩ. The capacitor values should be typically 20 pF-25 pF. The crystal frequency is 32,768 Hz.

The oscillator input can be externally driven, if desired. In this case the output should be left floating and the input levels should be within 0.3V of the supplies.

A ground line or ground plane between pins 9 and 10 may be necessary to prevent interference of the oscillator by the A4 address

Control Lines

The $\overline{\text{READ}}$, $\overline{\text{WRITE}}$, and $\overline{\text{CHIP SELECT}}$ signals are active low inputs. The $\overline{\text{READY}}$ signal is an open drain output. At the start of each read or write cycle the $\overline{\text{READY}}$ line (open drain) will pull low and will remain low until valid data from a chip read appears on the bus or data on the bus is latched in during a write. $\overline{\text{READ}}$ and $\overline{\text{WRITE}}$ must be accompanied by a $\overline{\text{CHIP SELECT}}$ (see *Figures 3 and 4* for read and write cycle timing).

Test Mode

The test mode is merely a mode for production testing. It allows the counters to count at a higher than normal rate. In this mode the 32 kHz oscillator input is connected directly to the ten thousandths of seconds counter. The chip select and write lines must be low and the address must be held at $1F_H$.

Figure 4.19. Real-Time Clock IC, Data Sheet (Sheet 4 of 8)

Functional Description (Continued)

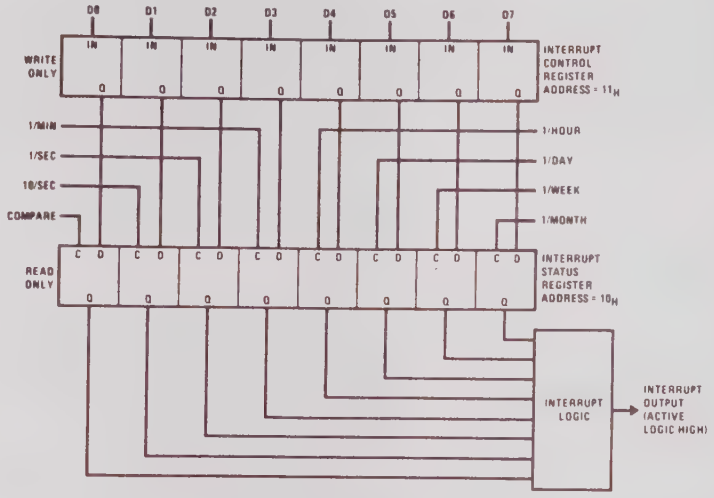


FIGURE 1. Interrupt Register Format

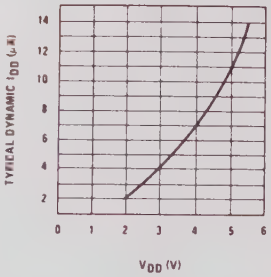


FIGURE 2. Typical Supply Current vs Supply Voltage

Interrupt Timing $-40°C \le T_A \le 85°C, 4.5V \le V_{DD} \le 5.5V, V_{SS} = 0V$

Parameter		Min	Max	Units
t_{INTON}	Status Register Clock to INTERRUPT OUTPUT (Pin 13) High (Note 1)		5	μS
t_{SBYON}	Compare Valid to $\overline{\text{STANDBY INTERRUPT}}$ (Pin 14) Low (Note 1)		5	μS
t_{INTOFF}	Trailing Edge of Status Register Read to INTERRUPT OUTPUT Low		5	μS
t_{SBYOFF}	Trailing Edge of Write Cycle (D0 = 0; Address = 16_H) to $\overline{\text{STANDBY INTERRUPT}}$ Off (High Impedance State)		5	μS

Note 1: The status register clocks are: the corresponding counter's rollover to its reset state or the compare becoming valid. The compare becomes valid 61 μs after the 1/10,000 of a second counter is clocked, if the real time counter data matches the RAM data.

Read Cycle Timing $-40°C \le T_A \le 85°C, 4.5V \le V_{DD} \le 5.5V, V_{SS} = 0V$

Parameter		Min	Max	Units
t_{AR}	Address Bus Valid to Read Strobe	100		ns
t_{CSR}	Chip Select to Read Strobe	0		ns
t_{RRY}	Read Strobe to Ready Strobe		150	ns
t_{RYD}	Ready Strobe to Data Valid		800	ns
t_{AD}	Address Bus Valid to Data Valid		1050	ns
t_{RH}	Data Hold Time From Trailing Edge of Read Strobe	0		ns
t_{HZ}	Trailing Edge of Read Strobe to TRI-STATE Mode		250	ns
t_{RYH}	Read Hold Time after Ready Strobe	0		ns
t_{RA}	Address Bus Hold Time from Trailing Edge of Read Strobe	50		ns

Note 2: If $t_{AR} = 0$ or $t_{DW} = 0$ and Chip Select, Address Valid, Read or Write are coincident then they must exist for 1050 ns.

Figure 4.19. Real-Time Clock IC, Data Sheet (Sheet 5 of 8)

Write Cycle Timing – $40°C \le T_A \le 85°C$, $4.5V \le V_{DD} \le 5.5V$, $V_{SS} = 0V$

Parameter		Min	Max	Units
t_{AW}	Address Valid to Write Strobe	100		ns
t_{CSW}	Chip Select to Write Strobe	0		ns
t_{DW}	Data Valid before Write Strobe	100		ns
t_{WRY}	Write Strobe to Ready Strobe		150	ns
t_{RY}	Ready Strobe Width		800	ns
t_{RYH}	Write Hold Time after Ready Strobe	0		ns
t_{WD}	Data Hold Time after Write Strobe	110		ns
t_{WA}	Address Hold Time after Write Strobe	50		ns

Data bus loading is 100 pF
Ready output loading is 50 pF and 20 kΩ pull-up
Input and output AC timing levels
Logical one = 2.0V
Logical zero = 0.8V

Read and Write Cycle Timing Diagrams

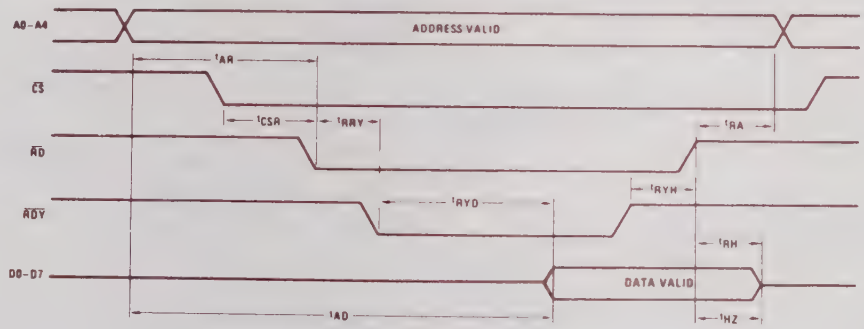


FIGURE 3. Read Cycle Timing

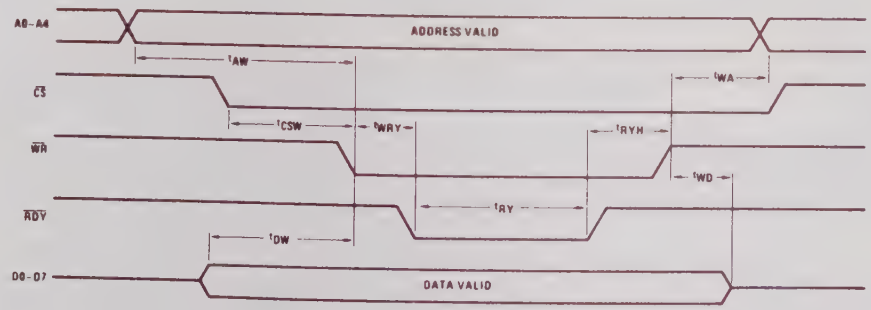
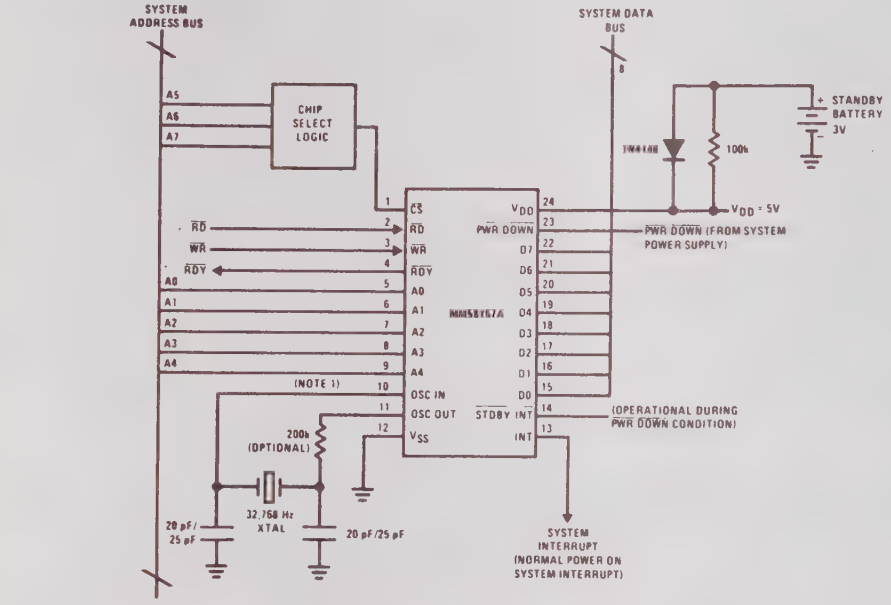


FIGURE 4. Write Cycle Timing

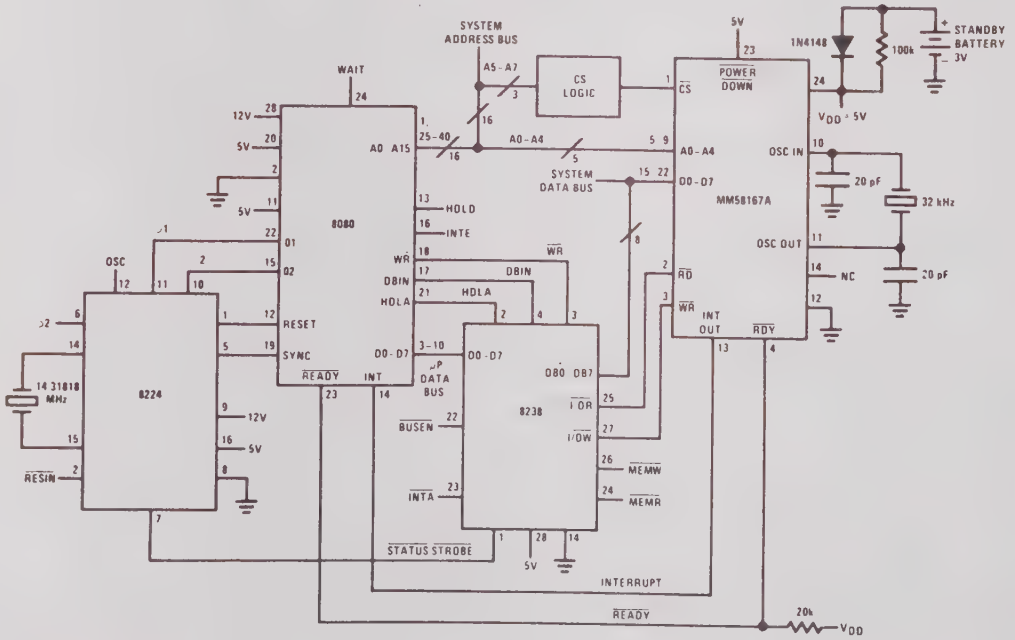
Figure 4.19. Real-Time Clock IC, Data Sheet (Sheet 6 of 8)

Typical Applications



Note 1: A ground line or ground plane guard trace should be included between pins 9 and 10 to insure the oscillator is not disturbed by the address line

FIGURE 5. Typical Connection Diagram



Note 1: Must use 8238 or equivalent logic to insure advanced I/OW pulse, so that the ready output of the MM58167A is valid by the end of $\phi 2$ during the T2 microcycle

Note 2: $t_{\phi 2} \geq t_{RS8080} + t_{DL8238} + t_{WRY58167A}$

FIGURE 6. 8080 System Interface with Battery Backup

Figure 4.19. Real-Time Clock IC, Data Sheet (Sheet 7 of 8)

Block Diagram

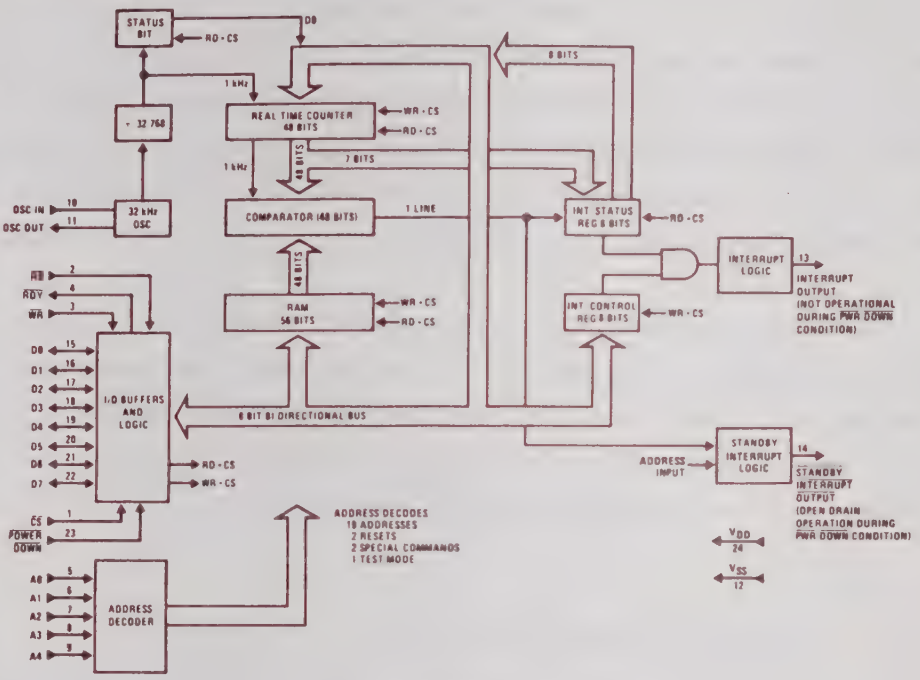
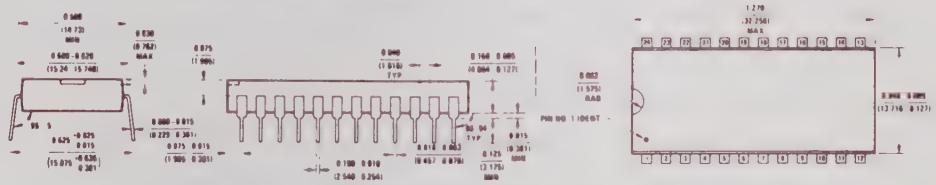


FIGURE 7

Physical Dimensions inches (millimeters)



Molded Dual-In-Line Package (N)
Order Number MM58167AN
NS Package Number N24A

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Figure 4.19. Real-Time Clock IC, Data Sheet (Sheet 8 of 8)

The "dead-man" timer consists of U24B and U25. In the absence of regular retriggering, periodic resets are generated by this circuit, allowing the microprocessor to recover from a "soft" error hangup condition. Associated with the dead-man timer, is the power-down timer which flags a power-down condition to the microprocessor, then restricts access to the non-volatile RAM and clock as power goes down. The dead-man timer is retriggered by reading port 58H or 5AH.

The rechargeable Ni-Cad battery, BT1, is equipped to charge from the +5 volt supply when the unit is on. In the absence of applied power, the battery supplies sufficient power to keep the RAM contents valid and the clock running. The capacity of the battery is sufficient to keep these circuits functioning for 3 to 6 months without external power.

4.5 MODEL 4654A ANALYZER OPTIONS

General. There are four options available to expand the operation of a Model 4654A Analyzer. They are designated as:

A. Option 304208: IEEE-488 Interface Bus
B. Option 304209: RS-232C Interface Bus
C. Option 304210: External Event Monitor Option
D. Option Model 4650: Printer

The following paragraphs provide description and theory of operation for these options. The information is provided in the same sequence as listed above. Options 304208 and 304209 are designed to occupy card slot A3 in the card cage and only one will be available during normal analyzer operation. Option 304210 is designed to occupy card slot A4 in the card cage and only one will be available during normal analyzer operation. Any option can be added to a receiver at a later date by qualified maintenance personnel using the Installation Procedures provided in the Operator's Manual. Option Model 4650 is an external electromechanical printer that is compatible with the receiver circuitry with or without the IEEE-488 or RS-232C options.

A. OPTION 304208: IEEE-488 INTERFACE BUS PCB

General. A block diagram of the IEEE-488 Interface Bus PCB is shown in Figure 4.20. The schematic for the optional Model 4654A IEEE-488 Interface Bus PCB is shown in Figure 7.57. The IEEE-488 Interface Bus PCB interfaces the Model 4654A Analyzer circuits to the IEEE-488 Interface Bus through a rear panel connector. These circuits are configured for I/O operation with a base address of A0H.

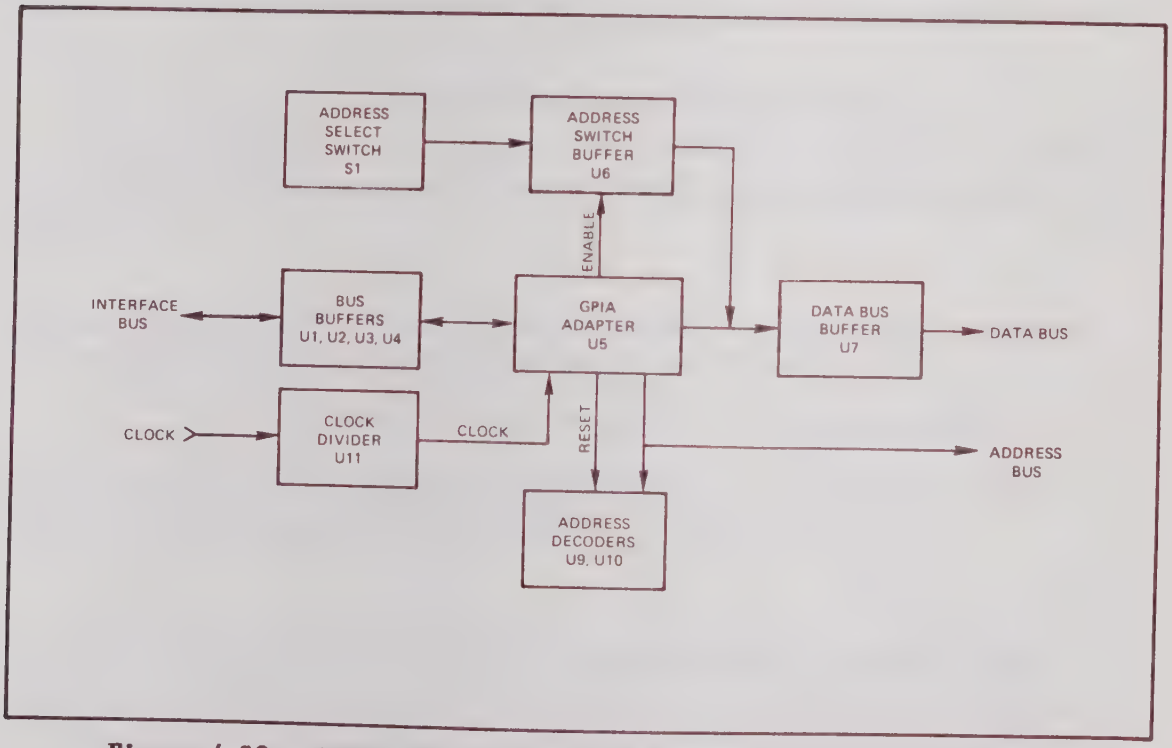


Figure 4.20. IEEE-488 Interface PCB Option (A3), Block Diagram

Detailed Description, General. The IEEE-488 Interface Bus PCB provides the hardware interface to mate the Model 4654A Analyzer microprocessor system bus to the IEEE-488 bus in the Listener or the Talk configuration, but not as the system controller. Considerable software overhead is also required to initialize the 68488 integrated circuit, which contains the bus interface logic, and to process Controller commands. Once initialized with talker/listener protocol set-up, data transfer can flow smoothly using the available

interrupts. IEEE Bus address switches are provided on the printed circuit board to establish talker/listener address definition.

To fully use the IEEE-488 Interface Bus PCB, the programmer must have a working knowledge of the IEEE-488 Interface Standard and Scientific-Atlanta adopted protocol. Descriptions in this section will be limited to port assignments and transfer of data with the 68488 IC. Some peculiarities of the software interface will not be described. For example, there is no explanation of how to process commands in the command pass through register or parallel poll register.

1. IEEE-488 Interface Bus PCB Specifications

Specifications applicable to the IEEE-488 Interface Bus PCB are as follows:

Primary Logic Element - 68488 General Purpose Interface Adapter automatically handles all handshake protocol on the IEEE-488 bus.

Power Requirements - +5.0V dc at 0.92 Amps (Max.)

IEEE Bus Connector - Connector J2 is compatible with Scientific-Atlanta No. 85050 using 26 conductor flat cable Scientific-Atlanta No. 82495, to Scientific-Atlanta No. 88368 IEEE Rear Panel connector.

Mating Connector and Pinout Chart. IEEE-488 Interface Bus PCB functions are provided through an 86-pin board edge connector located on the bottom of the printed circuit board. Signal pinouts are labeled on the schematic (see Figure 7.57).

2. Detailed Circuit Description

General. As with other microprocessor printed circuit boards, a single IC contains the logic which is the brains of the circuitry while other components simply provide system bus interface, buffering, and decoding. This is

also the nature of the IEEE-488 Interface Bus PCB. The 68488 IC, U5, automatically handles all handshake protocol on the IEEE-488 bus. The IC's U1 through U4, buffer drive the IC-U5 I/O into IEEE-488 bus compatible levels. The IC's U9 and U10 decode the system address bus and IC's U6 and U7 buffer the data bus and remaining various logic gate signals.

The following detailed circuit descriptions do not explain operation of the logic or the operation of the IEEE-488 bus since these functions are accomplished internally to circuit of IC-U5. The descriptions do involve the connection of the IC-U5 between the IEEE-488 and the 8080A Microprocessor system bus.

IC-U5, The 68488. This single IC automatically handles all handshake protocol on the IEEE bus. Features provided by this circuitry include the following:

1. Single or dual primary address recognition
2. Secondary Address capability
3. Complete Source and Acceptor handshake
4. Programmable Interrupts
5. RFD hold off to prevent data overrun
6. Serial and Parallel polling capability
7. Talk-only or listen-only capability
8. Synchronization trigger output

The 68488 is 6800 bus compatible and requires some adapter logic to make it 8080 bus compatible. The bus difference is basically that the 6800 is enabled and the clock input strobes data from the microcomputer bus into the IC, whereas the 8080 components are enabled and have separate I/O read and write pulses to strobe the data. The 68488 does not provide IEEE-488 bus termination and therefore requires the additional circuitry of bus drivers and terminators to provide buffering of the system data bus to the 8080 Microprocessor.

The schematic in Figure 7.57 shows that all of the 68488 IEEE bus connections are buffered onto the IEEE bus. The DIO0-DIO7 lines are bi-directional with TR2 (pin 27) output controlling the U3 and U4 buffer direction. The functional direction of signals Data Available (DAV), Ready for Data (RFD), and Data Accepted (DAC) are also controlled by TR2. Note that the functions

labeled Attention (ATN), Remote Enable (REV), and Interface Clear (IFC) are always inputs. The function Service Request (SRQ) is always an output and the direction of End of Identity (EOI) is controlled by TR1 (pin 28).

The circuits provided by U1 through U4 include IEEE bus drivers and terminators to make the 68488 electrically IEEE bus compatible. The system data bus, DB0 through DB7, connect directly to the 8080A Microprocessor data bus.

The Address Switch Enable (ASE) function at pin 4 of the 68488 enables U6 to put the address switch setting onto the data bus when the microcomputer is addressing Register 4 (which is actually the switch setting). The Chip Select function (U5, pin 3) is enabled when addressed through the operation of either U9 or U9/U10 decoders. Register Select Inputs (RS0, RS1, and RS2) connect directly to System Address Bits (AB0, AB1, and AB2, respectively) to select the various registers for I/O data transfers.

The 68488 Clock Input (pin 6) is connected to a "divide-by-two" circuit of the 2.048 MHz Phase 2 Clock (Ø2C) of the 8080 Microprocessor bus to produce a 1.024 MHz clock. Since the 68488 circuit uses the trailing edge of its clock input to strobe data for input, the clock input is also synchronized to the 8080 Microprocessor bus to correctly transfer data. This circuit is described later under the paragraph title "68488 Clock Synchronization Circuit".

The 68488 Read/Write (R/W) function is brought to a terminal for jumpering to IOW (for Normal I/O) or the MEMW (for Memory Mapped I/O). The reset line connects directly to the system control bus for system resets. The Interrupt Request (IRQ) output function is brought to a terminal where it is connected to and inverted by U8B, and the output is brought to another terminal. The first terminal (providing the IRQ function) permits jumpering to the single interrupt from the 8080A Microprocessor printed circuit board which is a negative true interrupt. The second terminal (providing the IRQ function) permits jumpering to one of the interrupts provided by the Interrupt Controller which are positive true interrupts. Note that the schematic shows that the 68488 Trigger Output (U5, pin 24) is also wired to a jumper terminal for picking up an interrupt.

68488 Clock Synchronizing Circuit. The 68488 IC is a dynamic device requiring continuous clocking with a frequency between 100 kHz and 1.0 MHz. Additionally, during I/O transfers, the trailing edge of the clock signal latches bus data into one of the eight addressed latches. The U11-D flip-flop is used to divide the 8080A Microprocessor 2.048 MHz Phase 2 Clock down to 1.024 MHz.

The phase of the flip-flop is controlled by gating the U11 internal feedback (U11, pin 6 shown as Q output) with the sync signal on the 8080A Microprocessor control bus. If the sync pulse is high during the T1 cycle of the 8080A Microprocessor, and if the U11 Q output (pin 5) is low at the beginning of T1, it is allowed to switch high on the next clock pulse. If the U11 output is high at this time interval, it is held high. The U5 clock input is now synchronized with the 8080A Microprocessor data transfer and produces a clock trailing edge during data valid on load to U5 data transfers.

Address Switch Enable. Register 4, shown on the 68488 data sheet, does not actually exist within the 68488 IC. During "reads" from this register, the 68488 outputs the inverted Address Switch Enable (ASE) at pin 4 which is used as an enable for a data bus buffer and puts the switch setting on the data bus.

The IEEE bus address switch, S1, is an eight-position, single pole switch with pull-up resistors provided by U13 and connected to U6 operating as an octal 3-state data bus buffer. When U6 is enabled by ASE, an address switch setting is put on the data bus to be read by the 8080A Microprocessor. Note that during initial power-up of the 68488, this address has to be read by the 8080A Microprocessor and then loaded into the 68488 address register to define the IEEE bus address for the 68488. The IEEE-488 bus address is a 5-bit address and the other 3 switch positions can be user defined through software for a desired function, such as talk-only or listen-only definition.

Address Decoding. Using the proper jumper selections, address decoding can be set up for either Memory Mapped I/O (16-line address) or for normal I/O (8-line address). The 16-line system address bus is used for both memory and

I/O accesses, but during the I/O operations, the 8-line address is duplicated on the upper and lower halves of the 16-line address bus. Circuits provided by U9, U10, and U12-A are grouped onto the address lines to provide decoding for either normal I/O or Memory Mapped I/O.

For normal I/O operation, U9 decodes three lines of 8-line I/O address (AB15, AB14, and AB13) to break the 256 address range into 8 blocks of 32 addresses. Terminal E18 is jumpered to one of the U9 outputs (E1 through E8) to select a 32-address block. At this time the U12-A output, which is gating AB3 and AB4 (the same as AB12 and AB11), and the selected U9 output will be high whenever any of the lower 8 addresses of the selected 32 address blocks are accessed. The U12-A signal function is inverted by U8-C to become the chip select for both the 68488 IC and U7, the bidirectional data buffer. The IC-U10 is not used for normal I/O.

B. OPTION 304209: RS-232C INTERFACE BUS PCB

General. A block diagram of the optional RS-232C Interface Bus PCB is shown in Figure 4.21. The schematic is shown in Figure 7.61. The RS-232C Interface Bus PCB interfaces the Model 4654A analyzer circuits to a compatible modem through a rear panel connector. These circuits are configured for I/O operation at RS-232C signal levels using the base address of 80H through 87H.

Detailed Description: General. The block diagram of the RS-232C Interface PCB (Figure 4.21) shows that the circuitry basically provides a Serial I/O function, Programmable Timer function, and a Rate Multiplier function.

The Ø2 clock at 2.048 MHz is multiplied by 9/10 in the decade rate multiplier (U24) and provided to the 8253 timer (U12) and CLK0 at 1.8432 MHz. The 8253 timer divides down from this signal in accordance with baud rate jumpers installed on the Error Counter PCB (A5) and provides the 8251A USART (U11) with a TX/RX clock at 16X, the operational baud rate.

The 8251A USART handles all asynchronous data communication between a System Controller (through a compatible modem) and the Model 4654A Analyzer.

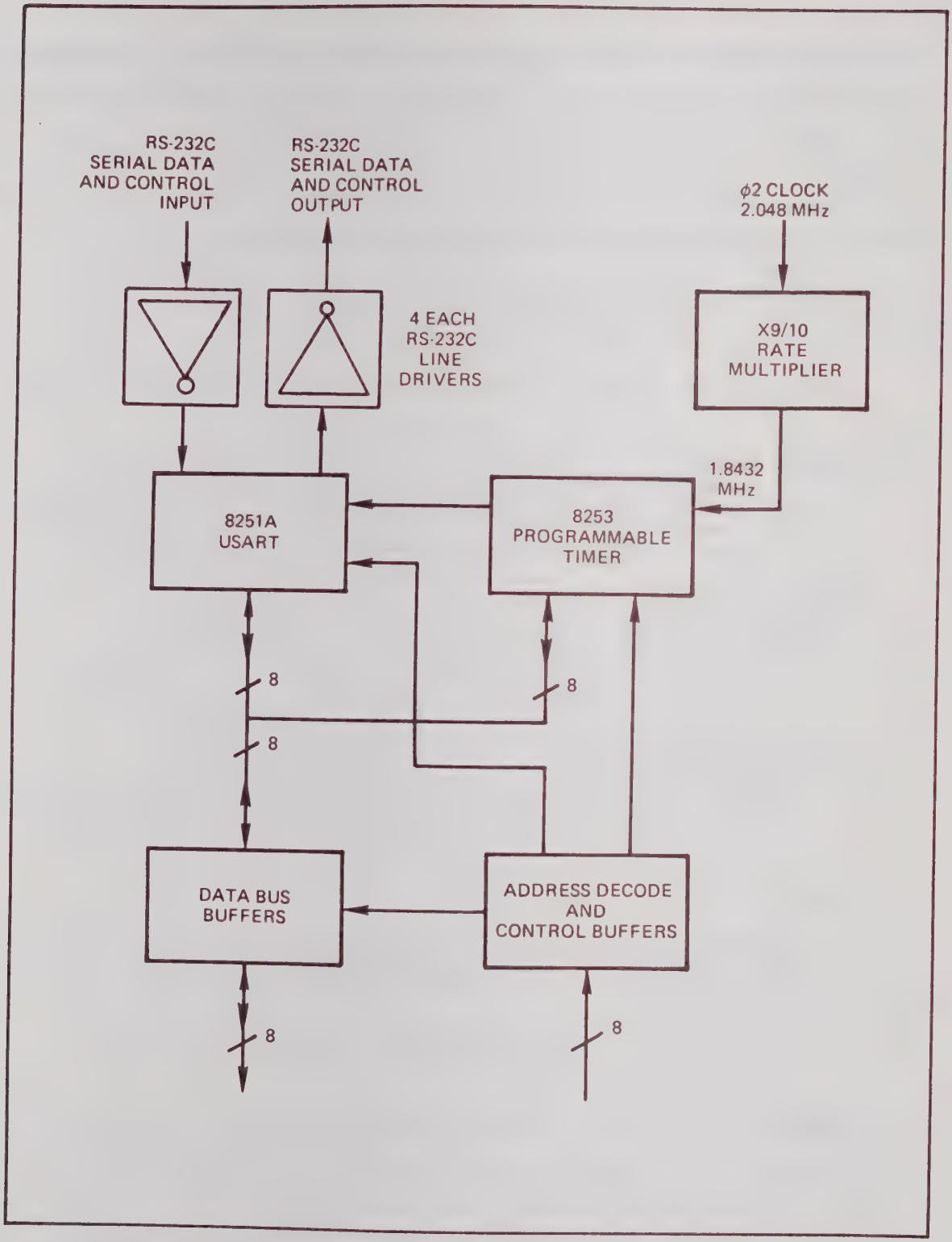


Figure 4.21. RS-232C Interface PCB Option (A3), Block Diagram

Interface buffers (U2 and U3) are provided to the 8251 serial I/O lines to allow EIA RS-232 signal levels. The buffers also provide that compatible output signals identified as Data Terminal Equipment (DTE) or Data Communication Equipment (DCE), will be as specified in RS-232C. The RS-232C Interface PCB uses ports 80H and 81H for the 8251A programmable interface component and ports 84H and 87H for the 8253 programmable timer component.

1. RS-232C Interface PCB Specifications

Specifications applicable to the RS-232C Interface PCB are as follows:

Primary Elements

A. One 8251A-type Programmable Communication Interface component.
B. Two 8259-type Programmable Interrupt Controller components.
C. One 8253-type Programmable Interval Timer component.

Power Requirements

+5.0V dc at 0.52 Amps (Max)
+12.0V dc at 0.025 Amps (Max)
-12.0V dc at 0.23 Amps (Max)

RS-232 Interface Connector

Connector J2 is compatible with Scientific-Atlanta Part No. 85050, using 26-conductor flat cable, Scientific-Atlanta Part No. 82495, to a Scientific-Atlanta Part No. 86242 "RS-232" rear panel connector.

Mating Connector and Pinout Chart

The RS-232C Interface functions are provided through an 86-pin board edge located on the bottom of the printed circuit board. All signal pinouts are labeled on the schematic (see Figure 7.61).

2. Detailed Circuit Description

General. The circuit components used by the RS-232C Interface PCB are 8080A Processor bus compatible and should be considered as system elements rather than individual components. The necessary jumpers and the proper command sequences have been identified in Chapter 3 of the Models 4654A Error Rate Analyzer Operator's Manual, to prepare this PCB to be compatible with both the Model 4654A Analyzer and the most common environments. The following

paragraphs identify other features available but not generally used in equipment of this design.

a. EIA RS-232 DCE or DTE Arrangement

Three pairs of signal wires must be cross-connected for the DCE or DTE configuration if the signals are to be used. There are many applications which use transmit data (TXD) and receive data (RXD) only and do not connect the Data Terminal Ready to Send (RTS) and Clear to Send (CTS) functions.

The six signal functions should be wired according to one of the following tables to complement the equipment configuration:

DCE Arrangement	DTE Arrangement
RXD; jumper E23 to E20	RXD; jumper E20 to E21
TXD; jumper E21 to E22	TXD; jumper E22 to E23
Optional	Optional
DTR; jumper E30 to E28	DTR; jumper E31 to E30
DSR; jumper E29 to E31	DSR; jumper E28 to E29
RTS; jumper E19 to E16	RTS; jumper E18 to E19
CTS; jumper E18 to E17	CTS; jumper E16 to E17

b. Timer Connections

Three separate timer inputs and outputs are available and may be: (1) jumpered in cascade, (2) jumpered to the Ø2 clock, or (3) jumpered to provide interrupt. Select the desired Timer connection listed in Table 4.3 to complement the circuit arrangement.

Additionally, three gate inputs for the timers are available for timer inhibits:

G0 = E32
G1 = E42
G2 = E40

The timers are actually 16-stage counters which can (through software) be set to operate in several modes. For baud rate generator, timers could be set for squarewave rate generator mode, and then set for binary or BCD division. To set a desired baud rate using the 2.048 MHz Ø2 clock, divide 2048000 by the baud rate and enter the rounded off whole number into the counter's inputs. Note also that 8251A has an interal programmable divider which must be correctly programmed to set the desired baud rate.

Table 4.3
RS-232C Timer Connections

Timer In/Out	Available Signals	
CLK 0 = E33	OSC E62	Interrupts
CLK 1 = E41	02 E44	I0 = E45
CLK 2 = E38	Baud Rate E35	I1 = E49
Out 0 = E34		I2 = E46
Out 1 = E43		I3 = E50
Out 2 = E39		I4 = E47
Outputs may be connected to clock input to cascade timers.		I5 = E51
		I6 = E48
		I7 = E52
		I8 = E57
		I9 = E56
		I10 = E55
		I11 = E58
		I12 = E54
		I13 = E59
		I14 = E53
		I15 = E60

c. Serial Interrupts

Three interrupt functions are available at the 8251 Programmable Communication Interface circuit arrangement. These functions are: (1) TXE (Transmit Empty, terminal E37) which will provide indication that transmit register and transmit buffer register is empty, (2) TXRDY (Transmit Ready, terminal E61) which will provide indication that the transmit buffer is empty and the transmitter is sending the last byte, and (3) RXRDY (Receive

Ready, terminal E36) which will provide indication that the receiver buffer is full and should be ready.

Loading the transmit buffers and reading the receive buffer will reset the corresponding interrupt function. Either or both buffer circuits may be jumpered to the same interrupt interval available to the timer. (Refer to B. Timer Connections)

d. Address Assignments

Eight separate four-address groups in the range from 80 to 9F are decoded and connected to jumper pins. The Serial I/O Port and the Interrupt Controllers use only two addresses of the four-address groups, and the Timer uses all four addresses of its assigned group. Table 4.4 identifies the jumper pin and the assigned function:

Table 4.4
Jumper Pin and Assigned Function

Port	Address
E9 = Int. Cont. 1 E9	E1 = 80-83
E10 = Int. Cont. 2 E10	E2 = 84-87
E13 = Timer	E3 = 88-8B
E14 = Serial I/O	E4 = 8C-8F
E5 = 90-93	
E6 = 94-97	
E7 = 98-9B	
E8 = 9C-9F	

e. Address Decoding and Data Bus Buffering

Component U5 is a 3-to-8 line decoder with three enable inputs of which two are low active and one is high active. The two low active enable inputs (U5, pins 4 and 5), are wired to Address bus lines AB5 and AB6, respectively. The high active input (U5, pin 6) provides an input to Address AB7 which is gated with BUSEN in the U9B circuit. Component U5 is enabled when AB5 and AB6 are low and AB7 is high. This corresponds to 100XXXXX on the Address bus which is the range from 80 to 9F.

Addresses AB2, AB3, and AB4 are wired to U5, pins 1, 2, and 3, respectively. These addresses are decoder inputs and select which of the eight active low outputs will be operated when U5 is enabled. The schematic shows these outputs are wired to jumper pins and will assign address for circuits of U1, U2, U3, and U6. The circuit of U1 will decode both addresses AB0 and AB1, while U2, U3, and U6 decode AB0 only.

The function BUSEN disables U5 for applications where an external device takes control of the sytem bus (i.e., a DMA controller). The U9A circuit provides chip select of U1, U3, U3, and/or U6 and also enables the data bus buffer (U4, pin 19) whenever a chip select is active. An indication is also provided showing an on-board device is being accessed by the microprocessor.

Component U4 is also a bi-directional buffer which is required since U1, U2, U3, and U6 cannot drive the system bus without assistance. The driving direction of U4 is controlled by the IOR signal. The function of U4 is to either buffer the data bus on to the printed circuit board when IOR is high, or buffer on-board data onto the system bus when IOR is low. The U4 circuit is only active when an on-board chip is selected.

f. 8251 Programmable Communication Interface (U6)

The 8251 Programmable Communications Interface component U6, operates: (1) bi-directionally with the data bus, (2) using Address AB0 to select the internal command or data register, (3) using various control bus lines to manage the data transfer, (4) using the U1 timer outputs to set the band rates, and (5) using the U7 and U8 circuits to produce EIA RS-232 levels.

The U6 data bus is bi-directional with direction controlled by the IOR and IOW signals with buffering onto the system bus provided through the operation of component U4. The 8251 circuit has command and data transfer modes which are selected by the address AB0. (It should be noted that several command modes are multi-byte sequences to the same address

and must be accomplished in a correct sequence). The address AB0-low selects data and AB0-high selects command and status. The system control bus signals used are RESET for intialization, and IOR/IOW for outputting/inputting data to/from the data bus, respectively.

The Transmit Clock (TXC) function (U6, pin 9) and the Receive Clock (RXC) function (U6, pin 25) are wired together on the printed circuit board. This restricts the U6 circuit to transmitting and receiving at the same rate. The TXC and RXC functions have a common connection to terminal E35 for jumpering to one of the timer outputs (terminal E34, E43, or E39) to set the data transfer rate. Refer to B, timer connections for typical timing connections and program divider constants. The 8251 serial outputs are: (1) at TTL drive levels, (2) the outputs are unipolar, and (3) in order to be EIA RS-232 compatible, the outputs must be level shifted and made bipolar. Similarly, RS-232 bipolar inputs must be shifted to TTL levels for normal operation.

The 1488-type component (U7) circuit can input the TTL levels from U6 and output the required +12/-12V bipolar RS-232 signal levels required for functions TXD, Syn Det, RTS, and DTR, as shown on the schematic. The 390 pF capacitors connected to the U7 outputs, control the signal rise time to be RS-232 compatible.

The 1489-type component (U8) circuit is used to accept bipolar RS-232 signal inputs and provides TTL logic level outputs. The 0.001 capacitors used on signal inputs provide RC filtering of the received signal. The 39K resistor will shift the threshold level slightly positive so TTL level inputs may also be used.

g. 8253 Programmable Interval Timer (U1)

The 8253 Programmable Interval Timer (U1) will: (1) operate bidirectionally with the data bus, and (2) use various control bus lines to manage the data transfer. Component U1 is provided with clock and gate inputs and outputs wired to jumper pins. The U1 data bus is bidirectional

with the direction being controlled by the IOR and IOW signal enabled by chip selection pin 1. Signals are buffered onto the system bus by U4, since U1 cannot drive a fully loaded system bus directly. The chip select function (U1, pin 1) is wired to terminal E10 where it can be jumper assigned to an address.

The IOR and IOW are the only control bus inputs and provide control of the data read and write functions. Addresses AB0 and AB1 are input from the address bus and select the appropriate internal data registers. The clock inputs (U1, pins 9, 15, and 18) are wired to board terminals where they can be jumpered to either the primary oscillator (18.432 MHz Standard) from terminal E62, the Phase (Ø2) Clock (2.048 MHz Standard) from terminal E44, or cascaded to another timing source output. These clock inputs are provided at U1, pins 10, 13, and 17, or terminals E34, E48, and E39, respectively. The timer outputs can be jumpered to an interrupt for timing measurements or to provide timing for the 8251 component (U6) circuits. A 10K pull-up resistor on the U1 input is provided to enable the gate inputs (U1, pins 11, 14, and 16) and to terminate unused clock inputs.

C. OPTION 304210 EXTERNAL EVENT MONITOR/MEMORY PCB (A4)

General. A block diagram of the External Event Monitor/Memory PCB is shown in Figure 4.16. The schematic for the option is shown in Figure 7.64. Refer to paragraph 4.4H section 2 for a detailed description of the circuitry on the External Event Monitor/Memory PCB Assembly (A4).

D. OPTION MODEL 4650: DOT MATRIX PRINTER

General. The Dot Matrix Printer consists of several major components. The printer mechanism and Control/Drive Card are purchased items and not manufactured by Scientific-Atlanta, but the remaining components (i.e., Printer I/O PCB, and switch) are made to Scientific-Atlanta specifications with assembly and final testing provided by Scientific-Atlanta. Consequently, the printer mechanism and Control/Drive Card are not considered field repairable

although this publication reprints some information from the Users Manual provided by Star Micronics, Inc., 200 Park Avenue, Pan Am Bldg., Suite 2308, New York, NY, 10166, to assist troubleshooting should the need arise. This information follows the description of the Scientific-Atlanta Printer I/O PCB and Switch Panel.

1. Printer I/O PCB (4650 (A2))

The Dot Matrix Printer I/O PCB is contained in the Dot Matrix Printer housing and interfaces with the Model 4654A Analyzer through the W1 cable. The schematic diagram for the Printer I/O PCB is shown in Figure 7.71. The Printer I/O PCB interfaces the Control and Data Bus from the 8080 Processor PCB (A1) to the printer Control/Drive Card so the data bit lines of the printer controller (DB0 to DB7) are connected to PB0 to PB7, respectively, on the 8080 Processor PCB. The remaining lines are connected as in the table.

Printer Function	8080 Processor PCB
$\overline{WR}$	PC0
$\overline{RESET}$	PC3
$\overline{ERROR}$	PC4
$\overline{BUSY}$	PC5
LOG ON	PC6
No Paper	PC7

The PC0 and PC3 lines are outputs from the 8080 Processor PCB to control the printer following the data transfer timing sequence illustrated in Figure 4.22.

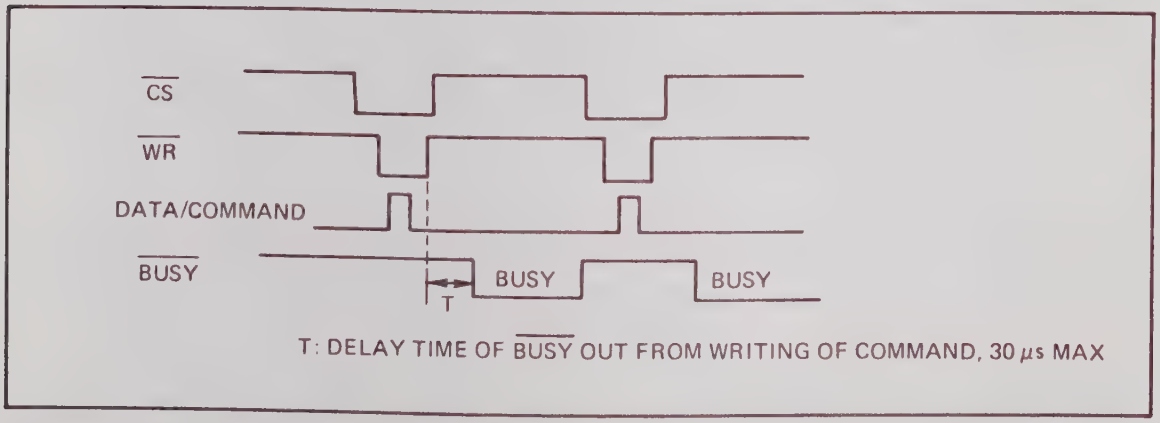


Figure 4.22. Dot Matrix Printer, Timing Sequence for Writing Character Data

The lines PC4 through PC7 are inputs to the 8080 Processor PCB to determine the status of the printer. Transistor Q2 inverts the RESET line from the 8080 Processor PCB to be the correct polarity required by the Control/Drive Card controller. The collector of transistor Q1 will pull LOG ON line function to ground (or to OFF state) whenever power is applied to the printer and the line function senses an open collector or no connection. A leaf-type microswitch (S1) provides the Paper Sense function which is required to protect the print head. The print head can prematurely wear out by attempting to print with no paper to absorb the shock of the printing needles. Components L1, C1, and C2 filter the 3.5 Ampere surge present when the print motor starts and, during operation, smooths the transients generated by the print head solenoids. Connector J3 interfaces both the POWER switch and PAPER ADVANCE switch on the front panel. When the POWER switch is operated to ON, connector pins J3-8, J3-9 are connected to J3-6, J3-7, and J3-4, J3-5 are connected to J3-2, J3-3. Operating the PAPER ADVANCE switch shorts J3-11 to J3-12.

2. Dot Matrix Paper Components

General. The Star control/drive card is equipped with an 8-bit parallel interface and is designed exclusively for the Star Series DP-822 (21 column) dot matrix impact printer. The card includes all drive electronics and control logic, an original Series DPC LSI printer controller chip, print solenoid driver, timing signal waveform shaping circuit, and a 6 MHz quartz crystal. The Star DP-series dot matrix printers can be fully controlled by a microcomputer system through its data and control bus. A block diagram of the control/drive card is shown in Figure 4.23.

Specifications for the Dot Matrix Printer are as follows:

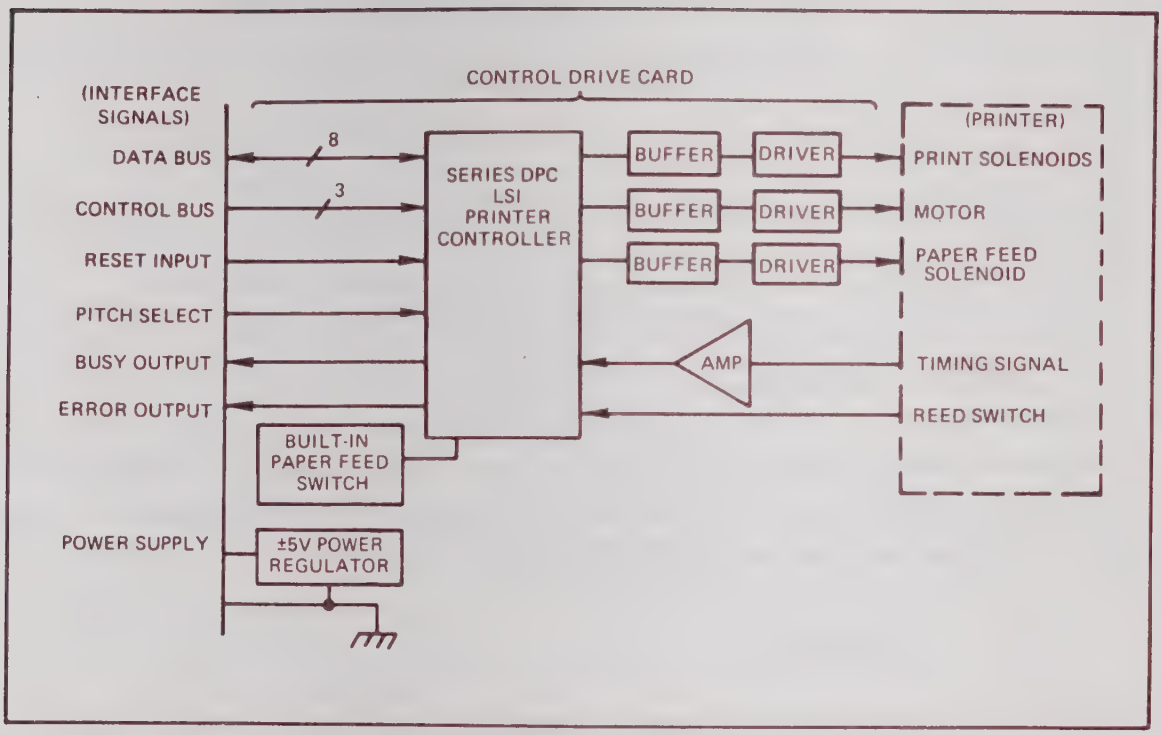


Figure 4.23. Dot Matrix Printer, Control/Drive Card, Block Diagram

Specifications for the Dot Matrix Printer

Star Printer Model No.	DP-822-08A	DP-822-08B
Controller	DPC-1	DPC-1
Marking on LSI	D8041C 534	D8041C 534
Character Buffer	21	21
Character Set	64 ASCII character set and 5 symbols	
Pitch Select (columns)	18/21	18/21
Power Supply (V dc)	+12 (±10%)	+12(+10/-5%)
Power Consumption		
Operation (peak)	3.5 Amps	3.5 Amps
Stand-by (max.)	150 mA	150 mA
Temperature (Celsius)		
Operating	+5.0° to +40°	+5.0° to +40°
Storage	-20° to +70°	-20° to +70°

Specifications for the Dot Matrix Printer
(continued)

Humidity (RH in %)		
Operating	30 to 80	30 to 80
Storage (max.)	95 to 40	95 to 40
Dimensions	4 in. x 6 5/16 in. (101mm x 161mm)	
Interface Connector (CN1)	All inputs TTL compatible	

Detailed Characteristics. The following entries provide some detailed characteristics of the Model 4650 Dot Matrix Printer used with the Model 4654A Analyzer. This information is part of the "User's Manual for the Dot Matrix Printer Control/Drive Card" from Star Micronics, Inc., 200 Park Avenue, Pan Am Bldg., Suite 2308, New York, NY, 10166.

a. Controller

The Control/Drive Card incorporates a special LSI controller chip component which provides the following features:

- Microprocessor compatible 8-bit DATA bus with three device control signal inputs (i.e., $\overline{CS}$, $\overline{RD}$, and $\overline{WR}$); two status output signals (i.e., $\overline{ERROR}$ and $\overline{BUSY}$); and three additional control signals inputs (i.e., $\overline{RESET}$, CP, and $\overline{FSW}$).
- A 5 x 7 matrix character generator for a 64 ASCII character set.
- A one-line print buffer (21 characters max).
- A programmable multiple line feed.
- Off-line test printing capability.
- Machine error detection capability.

b. Discrete Electronics

Components for the following circuits are included:

- Print solenoid driver.
- Motor driver.

- Paper Feed solenoid driver.
- Timing signal buffer (or pulse shaping circuitry)
- A +5.0V dc power regulator

c. 6.0 MHz Crystal

A 6.0 MHz quartz crystal is provided on the Control/Drive Card to supply a stable and fast clock timing for the DPC controller circuits.

d. Paper Feed Switch

A paper feed switch is provided on the Control/Drive Card for easy advancing of the paper supply. This switch can also be used for a test printing function.

e. Connectors

Four connectors are provided on the Control/Driver Card. Their general functions and mating connectors are identified in Table 4.5.

Table 4.5
Dot Matrix Printer, Control/Drive Card Connectors

Connector	Function	Mating Connector
CN1	Communicating with a microcomputer system	MOLEX 5049-15A
CN2	Connections for power supply, ground, and external paper feed input signal	MOLEX 5049-10A
CN3	Control/Drive Card signals to print head solenoids	UNION MACHINERY L25-014
CN4	Control/Drive Card signals for printer control	(Not applicable)

f. Interfacing

A block diagram showing the relationship of the Control/Drive Card connectors and their functions is shown in Figure 4.24. Connector pinout identification is provided in Table 4.6.

g. Mounting Considerations

The nominal dimensions of the Control/Drive Card are shown in Figure 4.25.

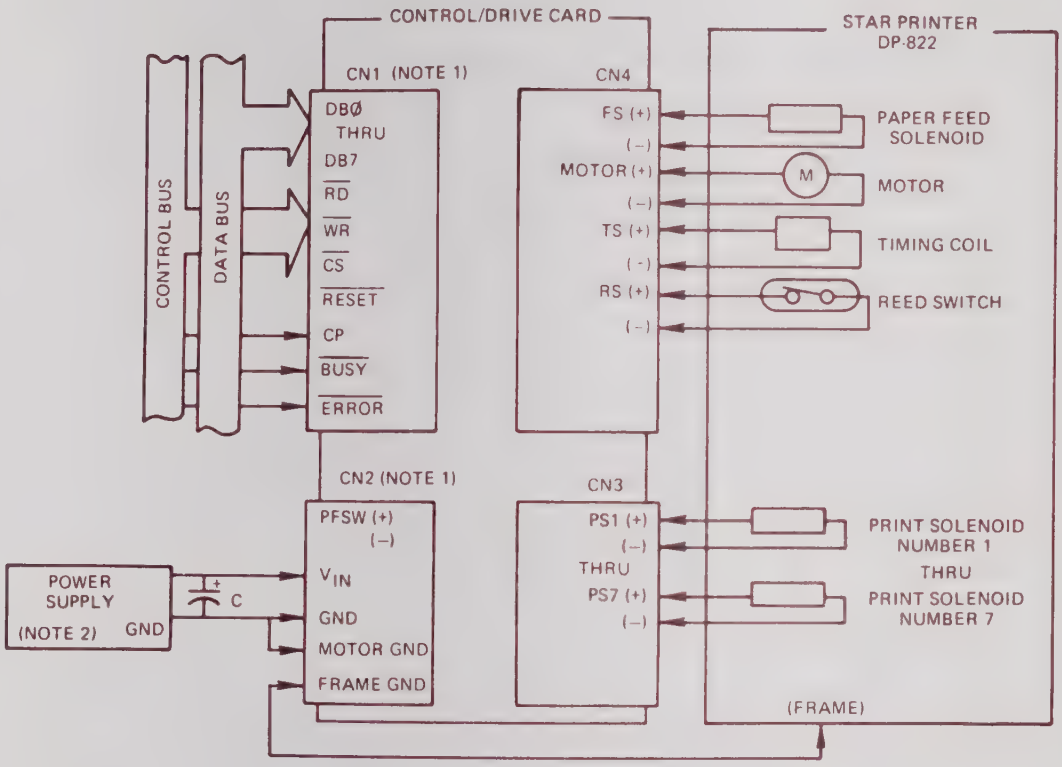
h. Operation

The Control/Drive Card is capable of communicating with a microcomputer through the DPC Controller bidirectional 8-bit data bus and device control signals. The device control signals and two status output signals are described in the following paragraphs, and Table 4.7 lists the character coding set that is unique to the operation of the Dot Matrix Printer. (See figures 4.26 thru 4.29 for component locations, and schematics for the Control/Drive cards.)

h1. Device Control Signals.

The operation mode of the Control/Drive Card is selected by shifting the three device control signals as shown below.

$\overline{CS}$	$\overline{WR}$	$\overline{RD}$	Mode	Data Bus
0	0	0	PROHIBITED	character data/command status
0	0	1	WRITE	
0	1	0	READ	
0	1	1	NO OPERATION	
1	X	X	DISABLING	



NOTES:
1. CONNECTIONS FOR CONNECTORS CN1 AND CN2 MUST BE WIRED CAREFULLY. REVERSE CURRENT WILL DAMAGE COMPONENTS.
2. POWER SUPPLY REQUIREMENTS:
   VOLTAGE: +12V (+10/-5%)
   CURRENT: 3.5 AMPS PEAK
   CAPACITOR: 10,000 μF RECOMMENDED

Figure 4.24. Dot Matrix Printer, General Interface Functions of the Control/Drive Card Connectors, Block Diagram

Table 4.6
Dot Matrix Printer,
Control/Drive Card Connector Pinout Identification

CN1

(for communicating with a microcomputer system)

Pin #	Pin Name	Description
1	$\overline{\text{ERROR}}$	Error Output
2	$\overline{\text{BUSY}}$	Busy Output
3	DB7	Data Bus b8
4	DB6	Data Bus b7
5	DB5	Data Bus b6
6	DB6	Data Bus b5
7	DB7	Data Bus b4
8	DB8	Data Bus b3
9	DB9	Data Bus b2
10	CP	Character Pitch Select In
11	DB0	Data Bus b1
12	$\overline{\text{WR}}$	Write Input
13	$\overline{\text{RESET}}$	Reset Input
14	$\overline{\text{RD}}$	Read Input
15	$\overline{\text{CS}}$	Chip Select Input

CN2

(for power supply & ext. paper feed)

Pin #	Pin Name	Description
1	PFSW (+)	Ext. Paper Feed Switch
2	PFSW (-)	
3	GND	Ground (0V)
4	GND	
5	NC	(+5V out of monitoring)
6	MOTOR GND	Ground for Motor (0V)
7	MOTOR GND	
8	FRAME	Ground for Printer Frame .
9	V_{IN}	+12V for 12V dc printers
10	V_{IN}	

Table 4.6 - continued

CN3

(for print head solenoids)

Pin #	Pin Name	Description
1	PS7 (-)	Print Solenoid for #7 Needle
2	PS7 (+)	
3	PS6 (-)	Print Solenoid for #6 Needle
4	PS6 (+)	
5	PS5 (-)	Print Solenoid for #5 Needle
6	PS5 (+)	
7	PS4 (-)	Print Solenoid for #4 Needle
8	PS4 (+)	
9	PS3 (-)	Print Solenoid for #3 Needle
10	PS3 (+)	
11	PS2 (-)	Print Solenoid for #2 Needle
12	PS2 (+)	
13	PS1 (-)	Print Solenoid for #1 Needle
14	PS1 (+)	

CN4

(for printer control)

Pin #	Pin Name	Description
1	NC	
2	RS (-)	Reed Switch
3	RS (+)	
4	TS (-)	Timing Signal
5	TS (+)	
6	NC	
7	FS (-)	Paper Feed Solenoid
8	FS (+)	
9	MOTOR (-)	Motor
10	MOTOR (+)	

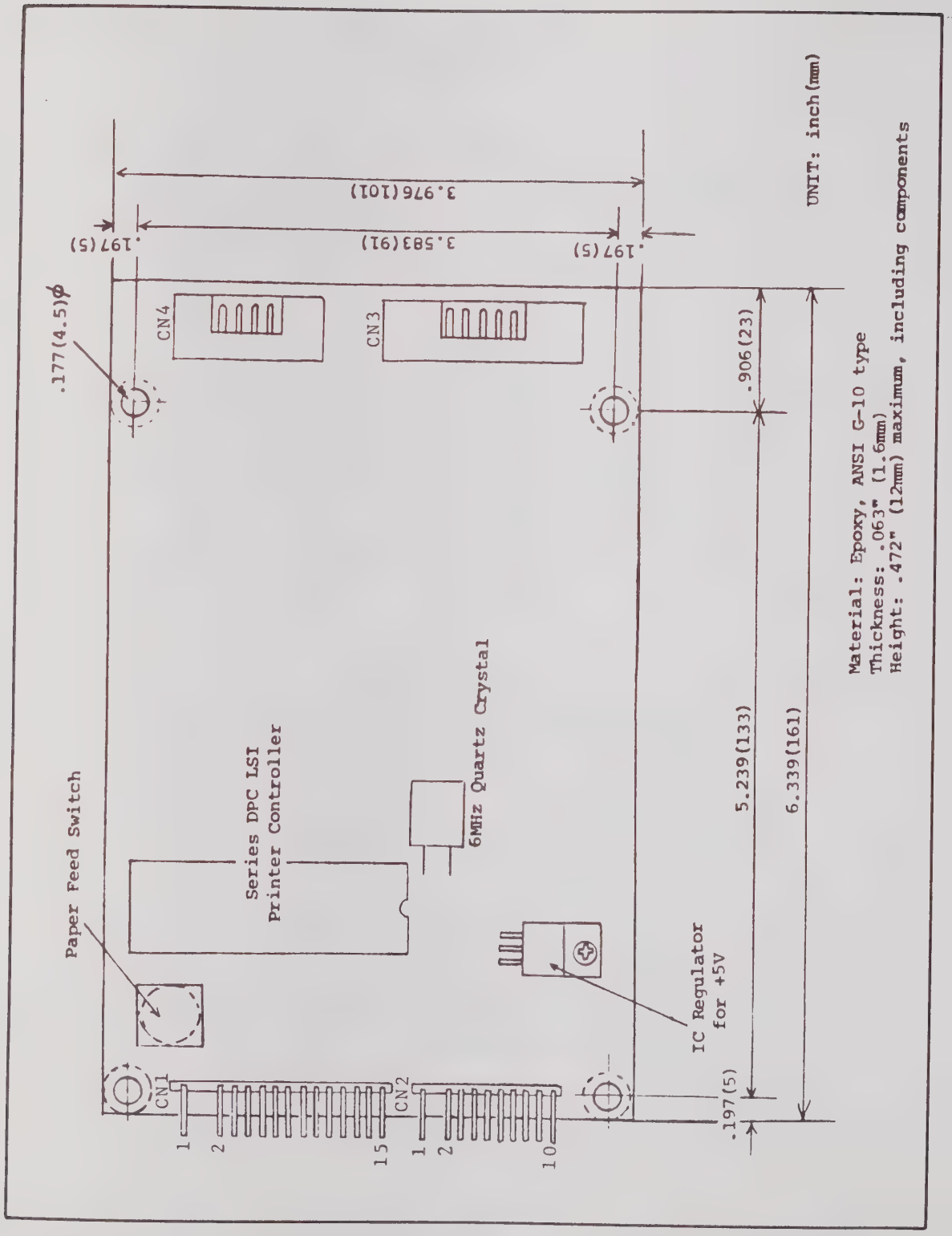


Figure 4.25. Dot Matrix Printer, Dimensions of the Control/Drive Card

Table 4-7
Dot Matrix Printer, Character Coding Set

				b8	0	0	0	0	0	0	0	0	1	1
				b7	0	0	0	0	1	1	1	1	1	1
				b6	0	0	1	1	0	0	1	1	1	1
b4	b3	b2	b1	col / row	0	1	2	3	4	5	6	7	E	F
0	0	0	0	0			SP	0	@	P				
0	0	0	1	1		DC1	!	1	A	Q				
0	0	1	0	2			"	2	B	R				
0	0	1	1	3			#	3	C	S				
0	1	0	0	4			$	4	D	T				
0	1	0	1	5			%	5	E	U				
0	1	1	0	6			&	6	F	V				
0	1	1	1	7			'	7	G	W				
1	0	0	0	8			(	8	H	X				
1	0	0	1	9			)	9	I	Y				
1	0	1	0	A	LF		*	:	J	Z				
1	0	1	1	B			+	;	K					
1	1	0	0	C			,	<	L					
1	1	0	1	D			-	=	M					
1	1	1	0	E			.	>	N					
1	1	1	1	F			/	?	O	_				

LF = Print/Paper Feed Command
DC1 = Controller Reset Command

h2. Reading Status of Data Bus Buffer.

	DBB:	D7	D6	D5	D4	D3	D2	D1	D0
$\overline{CS}$ = 0									
$\overline{WR}$ = 1		x	x	x	x	x	B	I	x
$\overline{RD}$ = 0									

IBF = Input-Buffer-Full Status

BUSY Status

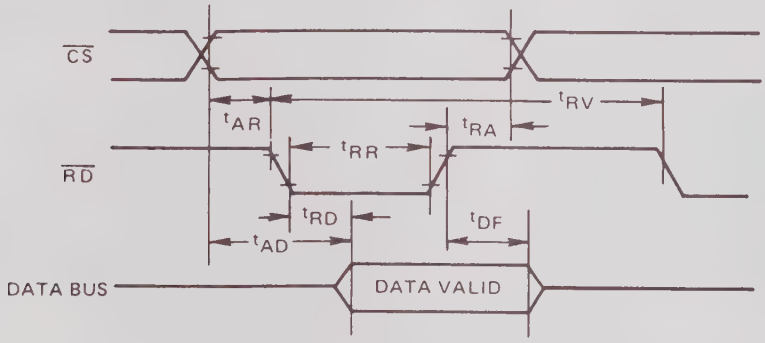
BUSY = 1 Busy
= 0 Not busy = Ready

Busy status is "1" during its processing the data entered or execution of the command. It must be "0" for new entry of data or command.

IFB = 1 Input buffer full
= 0 Input buffer clear

When a character or command is entered, it will be stored in an Input Buffer temporarily making the Input-Buffer-Full status "1". And when the data or command is processed, the IBF status becomes "0". It must be "0" for new entry of data or command.

Timing for Reading Status



DBB Read

SYMBOL	PARAMETER	MIN	TYPE	MAX	UNIT
t_{AR}	$\overline{CS}$ Setup to $\overline{RD}$↓	0			ns
t_{RA}	$\overline{CS}$ Hold after $\overline{RD}$↑	0			ns
t_{RR}	$\overline{RD}$ Pulse Width	250		5000	ns
t_{AD}	Delay, $\overline{CS}$ to data out			150	ns
t_{RD}	Delay, $\overline{RD}$ to data out			150	ns
t_{DF}	Delay, $\overline{RD}$ to data float	10		100	ns
t_{RV}	Recovery Time between RDs	1			ns

h3. Writing Character Data.

$\overline{CS}$ = 0	DBB:	D7	D6	D5	D4	D3	D2	D1	D0
$\overline{WR}$ = 0		b8	b7	b6	b5	b4	b3	b2	b1
$\overline{RD}$ = 1									
BUSY = 0									
IBF = 0									

The character data must be ASCII-coded. Table 2 page 8 shows a character coding set of acceptable ASCII characters and symbols.

h4. Writing Command.

a) Print/Paper Feed Command LF = 0AH

$\overline{CS}$ = 0	DBB:	D7	D6	D5	D4	D3	D2	D1	D0
$\overline{WR}$ = 0		0	0	0	0	1	0	1	0
$\overline{RD}$ = 1									
BUSY = 0									
IBF = 0									

When this command follows the writing of character data, the printer starts to print the data and advances the paper one line. Then the character data will be cleared from the line buffer in the series DPC controller.

If this command is entered without a preceding transfer of data, it is treated as a paper feed command.

Programmable Multiple Line Feed:

In addition, if the entry of this command is followed by an entry of data representing a number in binary code, the printer feeds the paper as many lines as programmed by this number.

DBB:	D7	D6	D5	D4	D3	D2	D1	D0
	0	0	0	n4	n3	n2	n1	n0

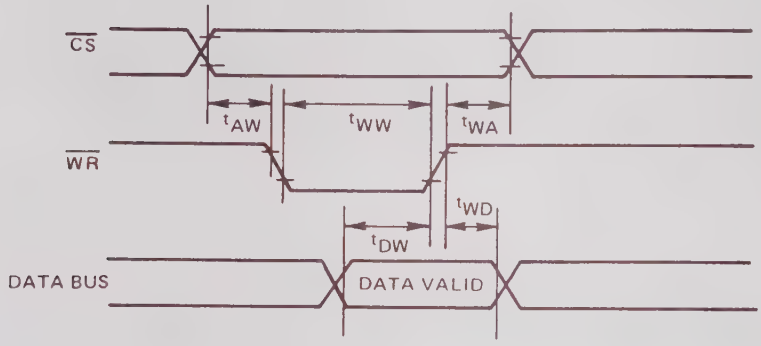
(programmable up to 31 lines)

b) Reset Command DC1 = 11H

$\overline{CS}$ = 0	DBB:	D7	D6	D5	D4	D3	D2	D1	D0
$\overline{WR}$ = 0		0	0	0	0	1	0	1	0
$\overline{RD}$ = 1									
BUSY = 0									
IBF = 0									

When this command is entered, a preceding transfer of character data or command, if any, will be cancelled as well as ERROR output.

Timing for Writing Character Data and Commands



DBB Write

SYMBOL	PARAMETER	MIN	TYPE	MAX	UNIT
t_{AW}	$\overline{CS}$ Setup to $\overline{WR}\downarrow$	0			ns
t_{WA}	$\overline{CS}$ Hold after $\overline{WR}\uparrow$	0			ns
t_{WW}	$\overline{WR}$ Pulse Width	250		5000	ns
t_{DW}	Data Setup to $\overline{WR}\uparrow$	150			ns
t_{WD}	Data Hold after $\overline{WR}$	0			ns

Parts Layout - Model 822-08A

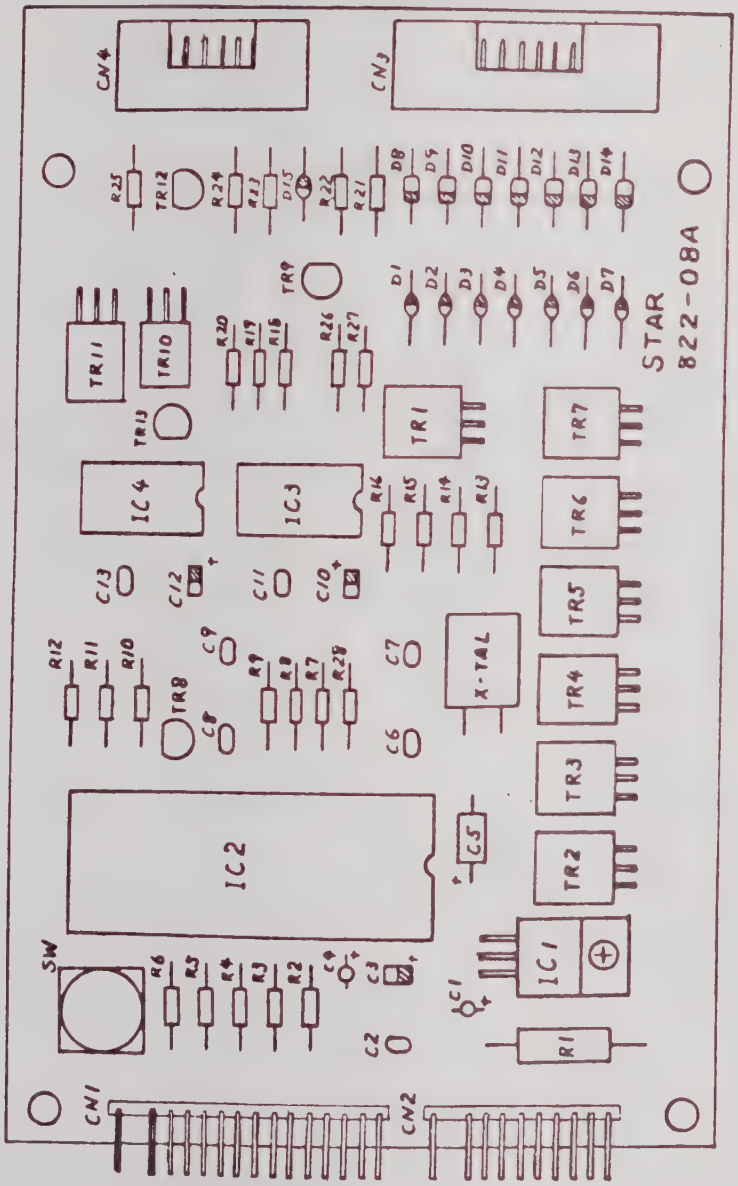


Figure 4.26. Control/Drive Card for Dot Matrix Printer Model 822-08A Component Location

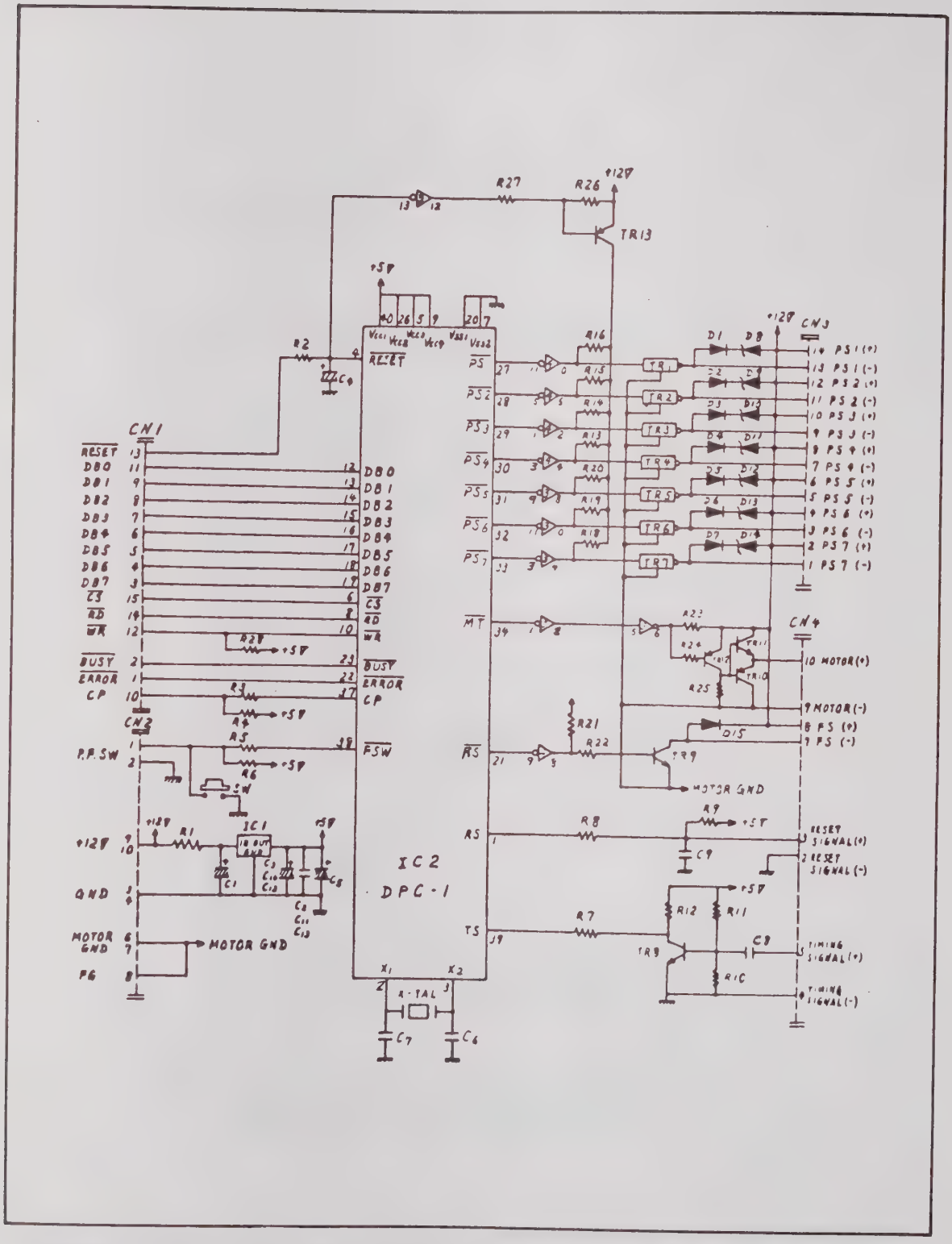


Figure 4.27. Control/Drive Card for Dot Matrix Printer Model 822-08A Schemtic Diagram

Parts List of Control/Drive Card for Model 822-08A

Type of Component	Star Part Number	Description	Qty.	Mfr's Number or Characteristics	Supplier
P.C. Board		Two-sided	1	822-08A	
IC	IC2	LSI, custom	1	DPC-1	NEC
	IC1	Constant voltage	1	μPC14305H	NEC
	IC3, IC4	TTL	2	SN7406	TI
Transistor	TR1-TR7	Power darlington	7	2SD558	NEC
	TR8		1	2SC945 (Q)	NEC
	TR9		1	2SC2001 (L)	NEC
	TR10		1	2SB564 (L)	NEC
	TR11		1	2SC1449 (L)	NEC
	TR12, TR13		2	2SA733 (Q)	NC
Diode	D1-D7, D15		8	F-14A	NEC
	D8-D14	Zener	7	RD-6.2F	NEC
				(watts) (ohms)	
Resistor	R1	solid	1	2W ±10%, 22 ohms	
	R2, R3, R5, R7 R8, R13-R16, R18-R20, R22	carbon	13	1/4W ± 5%, 1K	
	R4, R6, R11, R28	carbon	4	1/4W ±5%, 120K	
	R9	carbon	1	1/4W ±5%, 4.7K	
	R10	carbon	1	1/4W ±5%, 22K	
	R12, R23	carbon	2	1/4W ±5%, 10K	
	R21, R24	carbon	2	1/4W ±5%, 2.2K	
	R25	carbon	1	1/4W ±5%, 470	
	R26	carbon	1	1/4W ±5%, 560	
	R27	carbon	1	1/4W ±5%, 5.6K	
Crystal	X-TAL	6 MHz	1	HC-18U	YAGUMO TSUSHIN
Condensor	C1, C4	Tantalum	2	3.3 μF, 16V	NEC
	C2, C11, C13	Ceramic	3	0.022 μF, 50V UBD10W223K	TAIYO YUDEN
	C3, C10,, C12	Tantalum	3	6.8 μF CS99E1D6R8M	NEC
	C5	Aluminum	1	47 μF, 10V 10ELA47T	NICHICON
	C6, C7	Ceramic	2	20pF DT200YB20PF	NICHICON
	C8, C9	Ceramic	2	0.1 μF, 12V BD10X104X	TAIYO YUDEN
Switch	SW	Push Button	1	AKC8N	ALPS ELECTRIC
Connector	CN1		1	5049-15A	MOLEX
	CN2		1	5049-10A	MOLEX
	CN3		1	L25-014	UNION MACHINERY
	CN4		1	L25-010	UNION MACHINERY
Cable		with connectors for CN1 and CN2	1 set		

Parts Layout - Model 822-08B-12

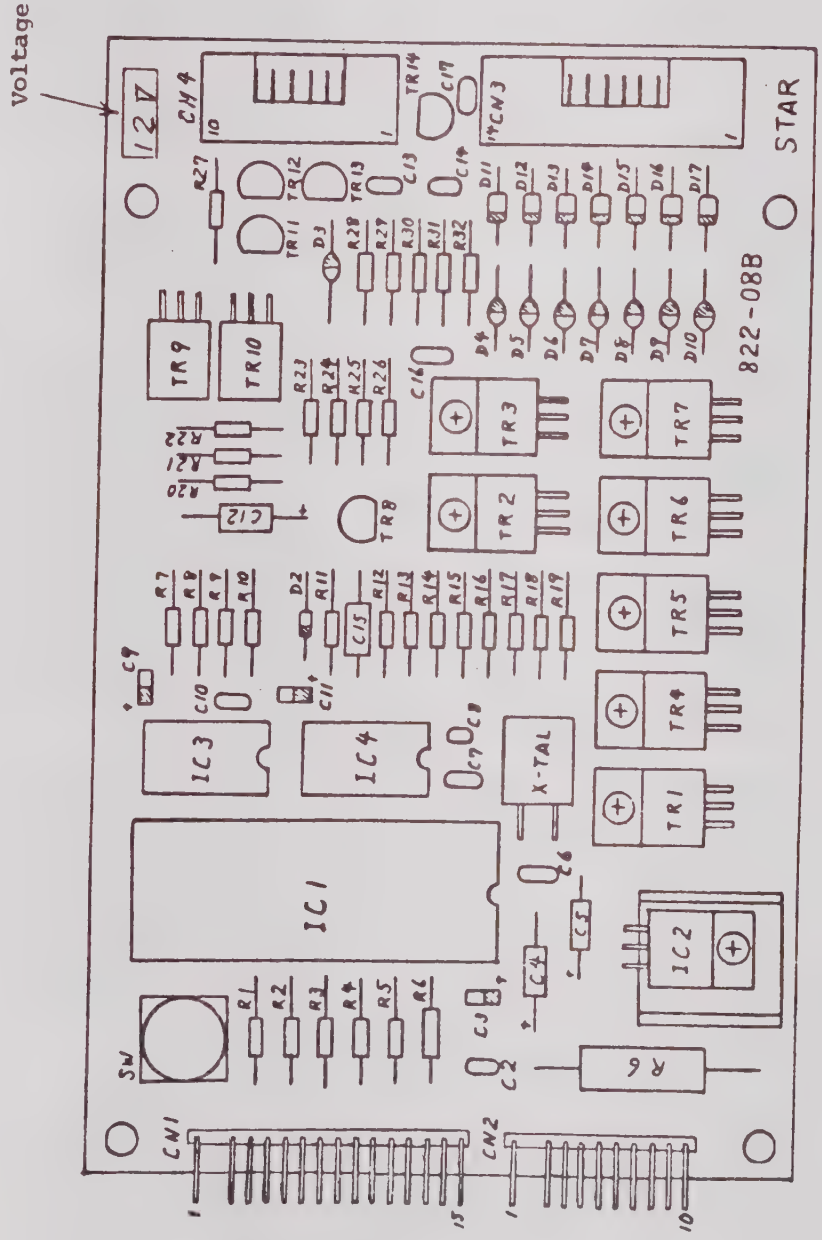


Figure 4.28. Control/Drive Card for Dot Matrix Printer Model 822-08B, Component Location

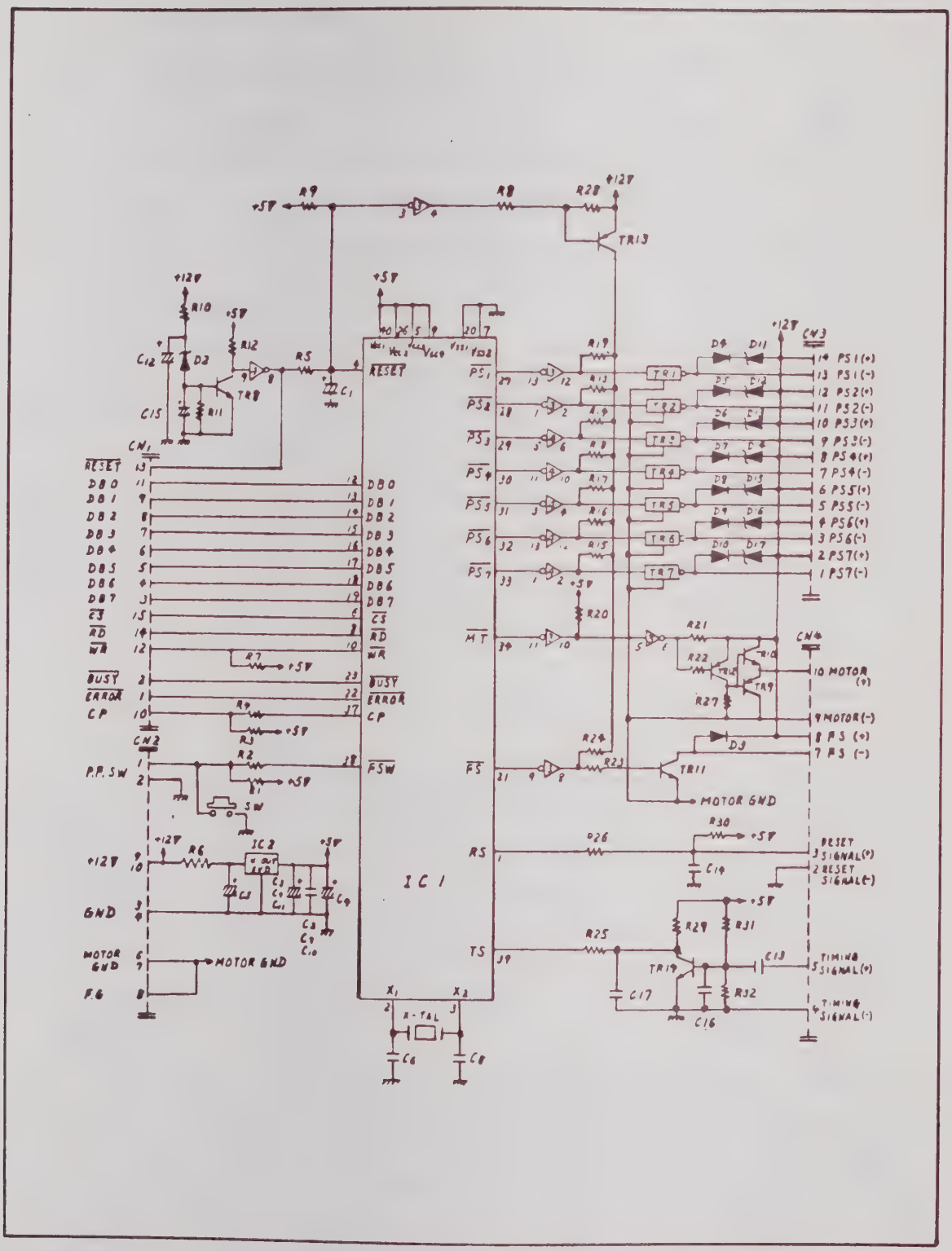


Figure 4.29. Control/Drive Card for Dot Matrix Printer Model 822-08B, Schematic Diagram

Parts List of Control/Drive Card for Model 822-08B

Type of Component	Star Part Number	Description	Qty.	Mfr's Number or Characteristics	Supplier
P.C. Board		Two-sided	1	822-08B	
IC	IC1	LSI, custom	1	DPC-1	NEC
	IC2	Constant voltage	1	μPC14305H	NEC
	IC3, IC4	TTL	2	SN7406	TI
Transistor	TR1-TR7	Power darlington	7	2SD686	TOSHIBA
	TR8, TR14		2	2SC945 (O)	NEC
	TR9		1	MJE700	MOTOROLA
	TR10		1	2SC1449 (L)	NEC
	TR11		1	2SC2120 (O)	TOSHIBA
	TR12, TR13		2	2SA733 (Q)	TOSHIBA
Diode	D2	Zener	1	HZ9C-2L	HITACHI
	D3-D10		8	F-14A	NEC
	D11-D17	Zener	7	RD-6.2F	NEC
				(watts) (ohms)	
Resistor	R1, R3, R7, R31	carbon	4	1/4W ±5%, 120K	
	R2, R4, R5, R23 R25, R26	carbon	6	1/4W ±5%, 1K	
	R6	carbon	1	2W ±5%, 22	
	R8	carbon	1	1/4W ±5%, 5.6K	
	R9	carbon	1	1/4W ±5%, 220K	
	R10, R11, R21 R29	carbon	4	1/4W ±5%, 10K	
	R12, R20, R30	carbon	3	1/4W ±5%, 4.7K	
	R13-R19, R22 R24, R27	carbon	10	1/4W ±5%, 2.2K	
	R28	carbon	1	1/4W ±5%, 560	
	R32	carbon	1	1/4W ±5%, 22K	
Crystal	X-TAL	6 MHz	1	HC-18U	YAGUMO TSUSHIN
Condensor	C1	Aluminum	1	3.3 μF, 50V	
	C2, C7, C10	Ceramic	3	TY(MS) type 0.022 μF, 50V	NEC
	C3, C9, C11	Tantalum	3	UBD10W223K 6.8 μF	TAIYO YUDEN
	C4	Aluminum	1	CS99E1D6R8M 47 μF, 6.3V	NEC
	C5, C15	Aluminum	2	TT(MS) type 1 μF, 50V	SHIN'EI TSUSHIN
	C6, C8	Ceramic	2	TT(MS) type 20pF	SHIN'EI TSUSHIN
	C12	Aluminum	1	DT200YB20PF 10 μF, 35V	NICHICON
	C13, C14	Ceramic	2	TT(MS) type 0.1 μF, 12V	SHIN'EI TSUSHIN
				BD10X104Z	TAIYO YUDEN
Switch	SW	Push Button	1	AKC8N	ALPS ELECTRIC
Connector	CN1		1	5049-15A	MOLEX
	CN2		1	5049-10A	MOLEX
	CN3		1	L25-014	UNION MACHINERY
	CN4		1	L25-010	UNION MACHINERY
Screw & Nut		Screw	1	TR3-7	
		Screw	7	TR3-5	
		Nut	8	N-3	
Heat Sink		Aluminum plate	1		
Cable		with connectors for CN1 and CN2	1 set		

4.6 OPERATIONAL PROGRAMS

A. GENERAL

The operational program for the Model 4654A Analyzer resides in up to 40K bytes of EPROM memory and uses 6K bytes of RAM. The Real-Time Clock PCB (A2) provides sockets for two 2764-type EPROM components which represent 16K bytes of memory and 2K of RAM. The 8080 Processor PCB (A1) also provides sockets for two 2764-type EPROM components which represent 16K bytes of memory, and other associated components provide the 2K bytes of RAM. The External Event Monitor/Memory PCB (A4) provides 2K of RAM and has provision for a 2764 EPROM. This EPROM is installed only if the External Event Monitor option is present. The program was written in a logical combination of FORTRAN and 8080 Assembly language. Also, the program was written in a highly modular form using structured programming techniques. Various routines and subroutines were connected through branch tables and linked using a linking loader. A floating point package tailored to this application provides the math capability required in normal operation.

B. ROUTINES

The interface driver routines required for the Model 4650 Printer, IEEE-488, and RS-232 options are supplied in EPROMs of all Model 4654A Analyzers. The software for the External Event Monitor option is supplied in an EPROM with the option. During the Power-Up interval, the initialization routines determine which option is installed and which driver routines to call during operation. By providing optional software in a single EPROM set, field installation and support have been simplified.

The Model 4654A Analyzer is of a software intensive design. The error counting hardware provides status lines, 50,000 bit interrupts, and two "wrap-around" error counters for Bit and Bipolar Violations. The program from these functions develops the Error-Seconds, Total Errors, Average BER, and formats the displays and printout messages. "Wrap-around" counter lengths are 16 bits for both Bit Errors and Bipolar Violations.

The software services the 50,000 bit interrupt every 8 milliseconds in DS2, every 16 milliseconds in DS1C, and every 32 milliseconds in DS1. When an interrupt occurs, the status latches and error counters are read. An increase in the error count is added to internal software accumulators. Each accumulator is 40 bits long. The hardware counters cannot overflow since they can count up to 65,536 errors, but are read every 50,000 bits.

C. MEMORY AND I/O ASSIGNMENTS

The operational program for the Model 4654A Analyzer resides in EPROM address locations ØØØØH to 3FFFH on the 8080 Processor and 4ØØØH to 7FFFH on the Real-Time Clock PCB. If the External Event Monitor option is included, its software is located in the EPROM on that PCB at 8ØØØH to 9FFFH. The 8080 Processor PCB (A1) contains 2K bytes of RAM at addresses EØØØH to E7FFH, however, due to non-unique decoding, it appears at each 2K block from EØØØH to FFFFH. The Real-Time Clock PCB (A2) contains 2K bytes of CMOS RAM at addresses D8ØØH to DFFFH. This RAM is provided a battery back-up and is used for storage of operating modes and data when the receiver power is off. The EE Monitor/Memory PCB contains 2K of RAM at DØØØH to D7FFH. The basic I/O assignments are listed in Table 4.6.

Table 4.8
Model 4564A Analyzer, Operational Program I/O Assignments

Hardware	Instruction	Port Address	Operation
Bit Error Counter	Input	2ØH	Input low order 8 bits of Bit Error Counter.
	Input	21H	Input high order 8 bits of Bit Error Counter.
Bipolar Violation Counter	Input	22H	Input low order 8 bit of BPV counter.
	Input	23H	Input high order 8 bits of BPV counter and reset 50,000 bit interrupt latch.
Receiver Status	Input	24H	Reads status information from various receiver boards.
Demultiplexer Status/Baud Rate	Input	25H	Reads status information from the optional DS3-DS2 Demultiplexer and reads baud rate setting for the optional RS-232C Interface.
Status Inputs	Input	26H	Zero Suppresison Select. NRZ Detect. DS1 PWB status. DS1 Framing status.
Receiver Control	Output	24H	Outputs control signals to the various receiver boards.
Receiver Control/ Demultiplexer Control	Output	25H	Outputs control signals to the various receiver boards and to the optional DS3-DS2 Demultiplexer.
Real-Time Clock	Input/Output	4ØH	Milliseconds counter, BCD (Top 4 bits)
	Input/Output	41H	Tenths and Hundredths of Seconds, BCD
	Input/Output	42H	Seconds, BCD
	Input/Output	43H	Minutes, BCD
	Input/Output	44H	Hours, BCD
	Input/Output	45H	Day of the Week, BCD
	Input/Output	46H	Day of the Month, BCD
	Input/Output	47H	Months, BCD
	Output	48H	Milliseconds comparison latch
	Output	49H	Tenths and hundredths of seconds comparison latch
	Output	4AH	Seconds comparison latch

Table 4.8 - continued

Hardware	Instruction	Port Address	Operation
	Output	4BH	Minutes comparison latch
	Output	4CH	Hours comparison latch
	Output	4DH	Day of the week comparison latch
	Output	4EH	Day of the month comparison latch
	Output	4FH	Month comparison latch
	Input	5ØH	Interrupt Status
	Output	51H	Interrupt Control
	Output	52H	Counter Reset
	Output	53H	Latch Reset
	Input	54H	Status Bit
	Output	55H	"GO" command
	Output	56H	Standby Interrupt
	Output	5FH	Test mode
Burst Counter	Input	58H/59H	Read number of bursts, power down and interrupt status bits.
	Input	5AH/5BH	Read length of error burst.
Front Panel I/O	Input/Output	7ØH	8279 Data, Read Switch Address or Write Display.
	Input/Output	71H	8279 Data, Control Register
	Output	72H/73H	LED displays
	Output	74H/75H	LED displays
	Output	76H/77H	LED displays
	Output	78H/79H	LED displays
	Output	7AH/7BH	TIME DISPLAY Colons
RS-232 Interface	Input/Output	8ØH/82H	8251A UART; DATA
	Input/Output	81H/83H	8251A UART; COMMAND/STATUS
	Input/Output	84H	8253; COUNTER Ø
	Input/Output	85H	8253; COUNTER 1
	Input/Output	86H	8253; COUNTER 2
	Input/Output	87H	8253; COMMAND/STATUS
	Output	88H-8BH	COUNTER 2 CLOCK
IEEE-488 Interface	Input/Output	AØH	Interrupt Status and Mask
	Input/Output	A1H	Command Status Register
	Input/Output	A2H	Address Mode
	Input/Output	A3H	Auxiliary Command
	Input/Output	A4H	Address Register
	Input/Output	A5H	Serial Poll Register
	Input/Output	A6H	Parallel Poll Register
	Input/Output	A7H	Data Register
EE Monitor/	Input	CØH/C4H	Reset Digit Select Counter

Table 4.8 - continued

Hardware	Instruction	Port Address	Operation
Memory	Input	C1H/C5H	Increment Digit Select Counter
	Input	C2H/C6H	DVM & Monitor Data & Flags
	Input	C3H/C7H	Strobe Status (Bit DØ Only)
	Output	C8H/CCH	Zero Suppression Control
8080 Processor PCB (A3) - Printer I/O	Input/Output	EØH	8255A; Port A
	Input/Output	E1H	8255A; Port B
	Input/Output	E2H	8255A; Port C
	Input/Output	E3H	CONTROL REGISTER

D. HARDWARE/SOFTWARE INTERFACING

There are five sources of interrupts to the microprocessor. They are identified as:

1. 50,000 bit interrupt
2. One second or 0.1 second pulses from the Real-Time Clock
3. Option installed (either RS-232 or IEEE-488)
4. Burst Counter
5. Power Fail detector

E. PRINTER DRIVER

The Model 4650 Printer receives data from a parallel I/O port on the 8080 Processor PCB (A1). The data is output in ASCII format with software generated READ, WRITE, and STROBE LINES. Input data consists of Printer OFF (or disconnected) and Out-of-Paper from the paper sense switch. Messages are formatted identical to operation with the RS-232C Interface Option PCB; but the data is separately buffered so that the difference in speed between a local Printer and an RS-232C Interface output (for example) will not slow down the faster device.

CHAPTER 5
MAINTENANCE

5.1 GENERAL

Due to the reliability and nature of the equipment, frequent maintenance and alignment of the Model 4654A Analyzer is not necessary or recommended. We recommend, however, all units be inspected and calibrated by Scientific-Atlanta personnel or representative on a yearly basis. This action insures that the equipment will meet the published specifications and provide you with trouble-free, accurate performance. The nearest Scientific-Atlanta representative or the nearest Regional Service Center can arrange for such factory calibration. Regional Service Centers are listed on the last page of this chapter.

5.2 TROUBLESHOOTING

The intent of this section is to enable the technician to repair equipment out of warranty by locating and identifying defective printed circuit boards. Once the defective printed circuit board has been isolated, either a pre-tested replacement unit may be obtained from Scientific-Atlanta or further troubleshooting may be performed. It is suggested that prior to troubleshooting within a printed circuit board that the technician review thoroughly the applicable section in the Theory of Operation, Chapter 4, and the appropriate schematic.

Signals received by and generated internally to the Model 4654A Analyzer are processed centrally by the microcomputer on the 8080 Processor PCB (A1), which controls functions such as routing and distribution through other various printed circuit boards. While it is not possible to describe all the failure modes associated with a Model 4654A Analyzer operating into a system, there are basic steps which can be performed to locate and isolate malfunc-

tions. This chapter is arranged to provide a logical sequence of basic procedures to isolate a fault within a Model 4654A unit.

The recommended tests should be performed and verified using a Hewlett-Packard Model 3465A Digital Volt Meter (DVM) for voltage and resistance measurements and a Tektronix Model 475 Oscilloscope to observe waveform patterns. The test equipment should be calibrated and operating within its specified accuracy. Equivalent or better test equipment may be substituted when required.

5.3 TROUBLESHOOTING MODEL 4654A ANALYZER

General. The following tests should be performed and verified using a Hewlett-Packard Model 3465A Digital Volt Meter (DVM) for voltage and resistance measurements and a Tektronic Model 475 Oscilloscope to observe waveform patterns. The test equipment should be calibrated and operating within its specified accuracy. Equivalent or better test equipment may be substituted when required.

Figure 5.1 is a flow-chart of step-test sequences to isolate a malfunction within a Model 4654A Analyzer. Obviously the malfunction symptoms will dictate which steps should be performed and which steps can be set aside as secondary or to be performed if the initial steps fail to isolate the malfunction. If a malfunction is isolated to a printed circuit board which can be field calibrated (i.e., a power source PCB), perform the entire calibration procedure before attempting to verify normal operation. If a malfunction is isolated to a source that is not field repairable (i.e., 8080 Processor PCB (A1) et.al.) and/or does not respond to normal repair procedures and/or calibration, then the suspect source should be replaced by an identical item purchased from Scientific-Atlanta.

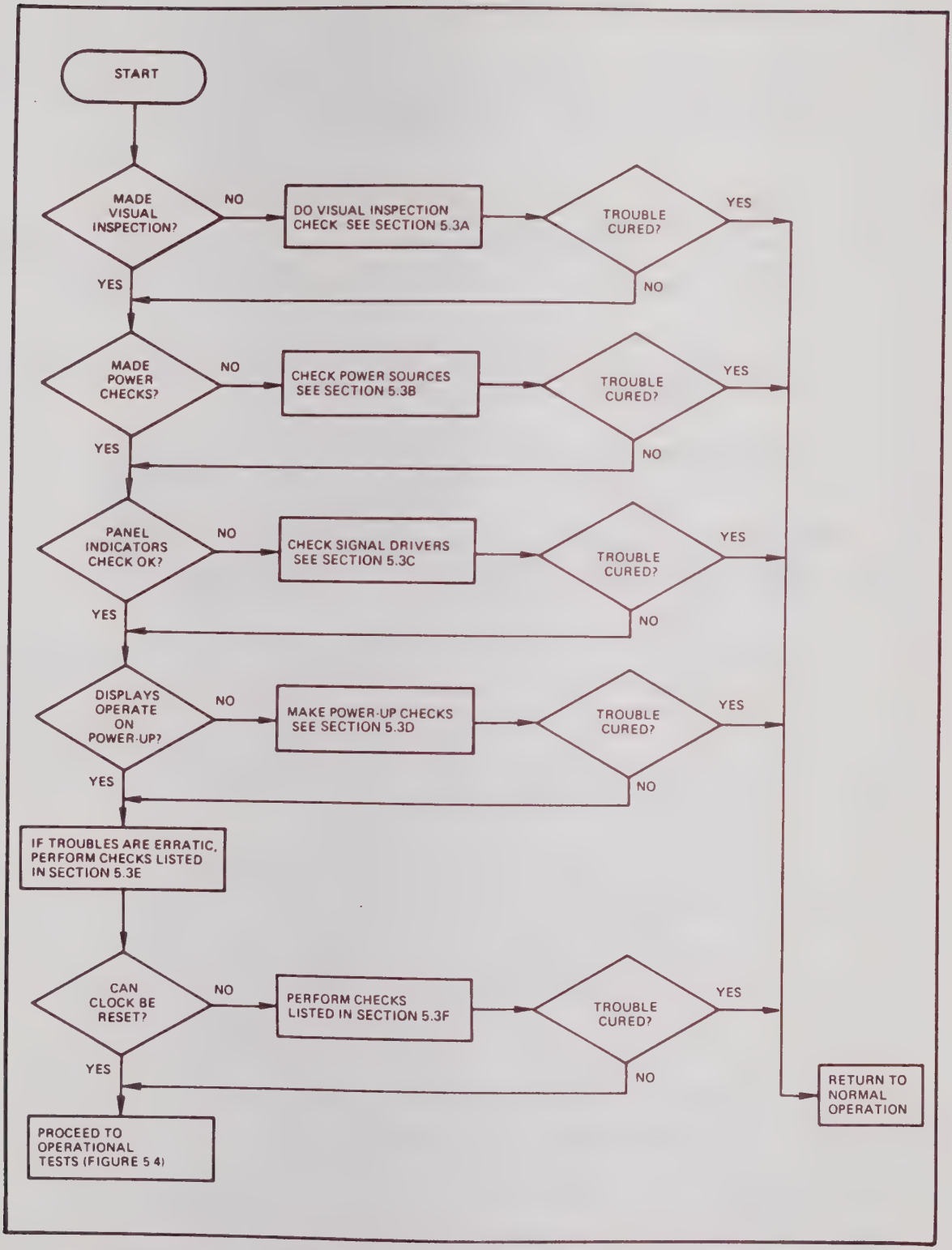


Figure 5.1. Model 4654A Analyzer Troubleshooting Flow Chart

A. MODEL 4654A VISUAL INSPECTION

A visual inspection check of a Model 4654A Analyzer should consist of the following steps as a minimum:

- Check all PCB's for proper installation and location.
- Check for broken wires. This includes all PCB connections, coax and flat cables, and panel connections. Observe PCB components for obvious defects (i.e., discoloration, bulging, overheating).
- Check that all cables are properly installed. Use Figure 7.1 or 7.2 for reference. Also inspect for bent pins, deformed connector shells, frayed or punctured insulation, etc.

B. MODEL 4654A POWER SOURCES

Model 4654A Power Sources. A check of the Model 4654A Analyzer power sources should be verified using the DVM and the following tests:

1. Check the AC Input source (if used). Determine if the ac source is controlled by a switch. Check the source ac at the chassis connector. Verify that the voltage select PCB next to the ac fuse is properly installed. (See Figure 5.2). Check the ac fuse for continuity. Check ac distribution using schematic diagrams in Chapter 7. Verify the following requirements. If the requirements are not met, troubleshoot and repair the AC linear power supply PCB. (If unit contains this type of power supply).

   On PCB A12, measure from TP-2 (COM) to TP-1.

   Requirement: ±5.00 (±0.25)V dc

   On PCB A12, measure from TP-4 (COM) to TP-3.

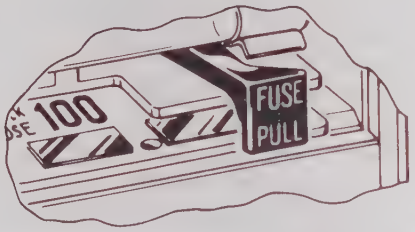
   Requirement: ±12.00 (±0.1)V dc

   On PCB A12, measure from TP-4 (COM) to TP-6.

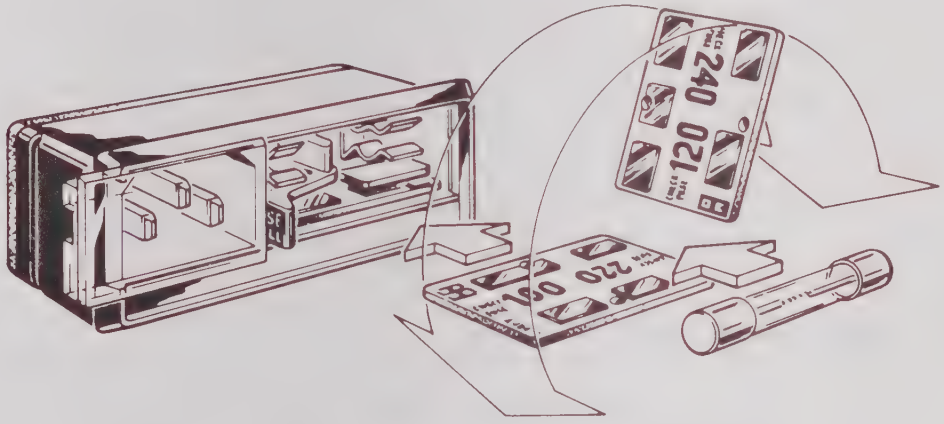
   Requirement: -12.00 (±0.1)V dc

   On PCB A12, measure from TP-4 (COM) to TP-5.

   Requirement: -5.00 (±0.25)V dc



Operating voltage is shown through the sliding plastic window.



HOW TO SELECT OPERATING VOLTAGE

1. Remove the ac power cord connector.
2. Slide the plastic window to the left.
3. Carefully operate FUSE PULL tab to the left.
4. Carefully remove both the fuse and printed circuit board. A small hole is provided to accommodate a wire pull if necessary.
5. Correctly orient the printed circuit board so the desired voltage is located on the top left side.
6. Carefully return the printed circuit board to the original location. Be sure it is securely seated.
7. Return FUSE PULL tab to the normal position.
8. Replace the original fuse with one selected for correct fuse value.

Illustrations courtesy of Corcom Corp., Chicago, Ill.

Figure 5.2. Selecting the Proper Operating Voltage

2. Check the DC input source (if used). Determine if the dc source is connected using the correct polarity. Check the dc fuses on the Rectifier and Filter Assembly PCB (A15A1) for continuity. Check the input dc source distribution using schematic diagrams in Chapter 7.

3. Check the operation of the -5.2V/-12V Power Supply PCB (A12) and the +5V/+12V Power Supply PCB (A13). Verify the following requirements. If the requirements are not as shown, then troubleshoot and repair the power supply PCB.

On PCB A12, measure from J1-3 to J1-1.

Requirement: -5.2 (±0.3)V dc

On PCB A12, measure from J1-3 to J1-9.

Requirement: -12 (±0.4)V dc

On PCB A13, measure from J1-1 to J1-5.

Requirement: +12 (±0.4)V dc

On PCB A13, measure from J1-3 to J1-5.

Requirement: +5.1 (±0.1)V dc

C. MODEL 4654A PANEL INDICATORS

A check to verify that the Model 4654A Analyzer front panel indicators are properly conditioned is provided in the following tests. Remember that the front panel LED's are multiplexed using a clock signal from the 8080 Processor PCB (A1).

- Verify that the 8080 Processor PCB (A1) is providing a 1.8 MHz clock signal at pin C. (Using the extender card for this test is recommended. Return equipment to original condition after testing.)

- Thoroughly inspect the 50-conductor flat cable connecting to the Front Panel I/O PCB (A14A4). Test for open conductors and/or high resistance connections. Figure 7.50 is the cable schematic.

- Check for proper installation of the Front Panel I/O PCB (A14A4) to the front panel. Observe for bent connector pins and/or misalignment of the PCB that could allow a short circuit or other types of signal malfunctions.

D. MODEL 4654A POWER-UP CHECKS

Checks to verify the Model 4654A Analyzer Power-Up sequence are simple. With proper AC/DC source input voltage applied, operating the POWER ON switch will cause the front panel displays to illuminate and the TIME display to indicate running time. The displays will not illuminate unless there is proper AC/DC source input applied. The battery backup provides the Real-Time Clock PCB (A2) with sufficient power to keep current time and date information and valid data in the two CMOS RAMS A2-U9 and U10, only. If the TIME display is erratic, the battery may be fully discharged. The battery will normally recharge while the equipment is provided external source power. If the TIME display does not start a running count within ten minutes (supposing the battery was completely discharged), use a DVM to measure the battery voltage. A running TIME display should be observed if the battery voltage is over 3.0V dc, and battery voltage could measure approximately 4.0V dc while being charged. If the charging rate does not exceed 3.0V dc, the battery should be replaced. It should be noted that the Model 4654A Analyzer can operate without the battery, but each Power-Up sequence will require the TIME display to be reset, and data in the CMOS RAMS will be lost.

E. MODEL 4654A ERRATIC PERFORMANCE

Erratic performance can sometimes be notable after the power-up sequence. Occasionally a program does power-up RESET, especially after a timed test. The following checks have been used to correct erratic performance during manufacture checkout.

- Replace both RAM components, A1U14 and A1U15 (two 2114-type IC's) on the 8080 Processor PCB (A1).
- Operate the Real-Time Clock PCB (A2) through the card extender. Examine signals on the Power Fail line (pin 17) being input from the Power Supply. If the signal is noisy and if A2U24, pin 5, is a logic "0" add to or verify the 1.0 uF, 100V dc capacitor (A13C17) across resistor A13R37 on the +5.0V/+12V Power Supply PCB (A13).
- Replace the 8080 Processor PCB (A1) with one known to be good.
- Replace the Real-Time Clock PCB (A2) with one known to be good.

F. MODEL 4654A REAL-TIME CLOCK RESET

The Model 4654A Analyzer Real-Time Clock display is a prominent feature and often is the first indication of equipment malfunction. The following tests should be performed if resetting the TIME display presents a problem.

- Perform the second test listed in paragraph E above regarding capacitor A13C17. This component may be the cause of an invalid TIME display. Replace A13C17 if necessary.
- Use the oscilloscope and test the Bus Decoders (A2U15 and U7) on the Real-Time Clock PCB (A2). Replace if necessary.

5.4 MODEL 4654A ANALYZER OPERATIONAL TESTS

General. There will be times when the fastest method of identifying Model 4654A Analyzer malfunctions and the isolation of a fault is to inject a valid data signal and observe the resulting indications. The sequence, as shown in Figure 5.3 and used in the following procedures, provides interpretation of some common failures with suggested diagnostic steps to rapidly isolate a malfunction. The term "valid signal" used in the following procedures should be understood as a signal such as generated and output from a Model 4653A Transmitter known to be operating within its specified range and accuracy. An equivalent signal may be substituted if available.

A. SIGNAL LOSS FAILURE

If the Model 4654A Analyzer indicates normal operation (i.e., no faults as indentified in Section 5.4) but applying a valid DS1/1C/2 signal input causes the SIGNAL LOSS indicator to illuminate, perform the following tests:

- Place Clock Recovery PCB (A10) on the extender card and with a valid bipolar DS1/1C/2 signal applied to the Model 4654A Analyzer, check TP3 with an oscilloscope for the presence of a bipolar signal.
- If a bipolar signal is present at TP3, readjust LOST SIGNAL SET potentiometer R55 following instructions in paragraph E - Lost Signal Set of the calibration section of this chapter.

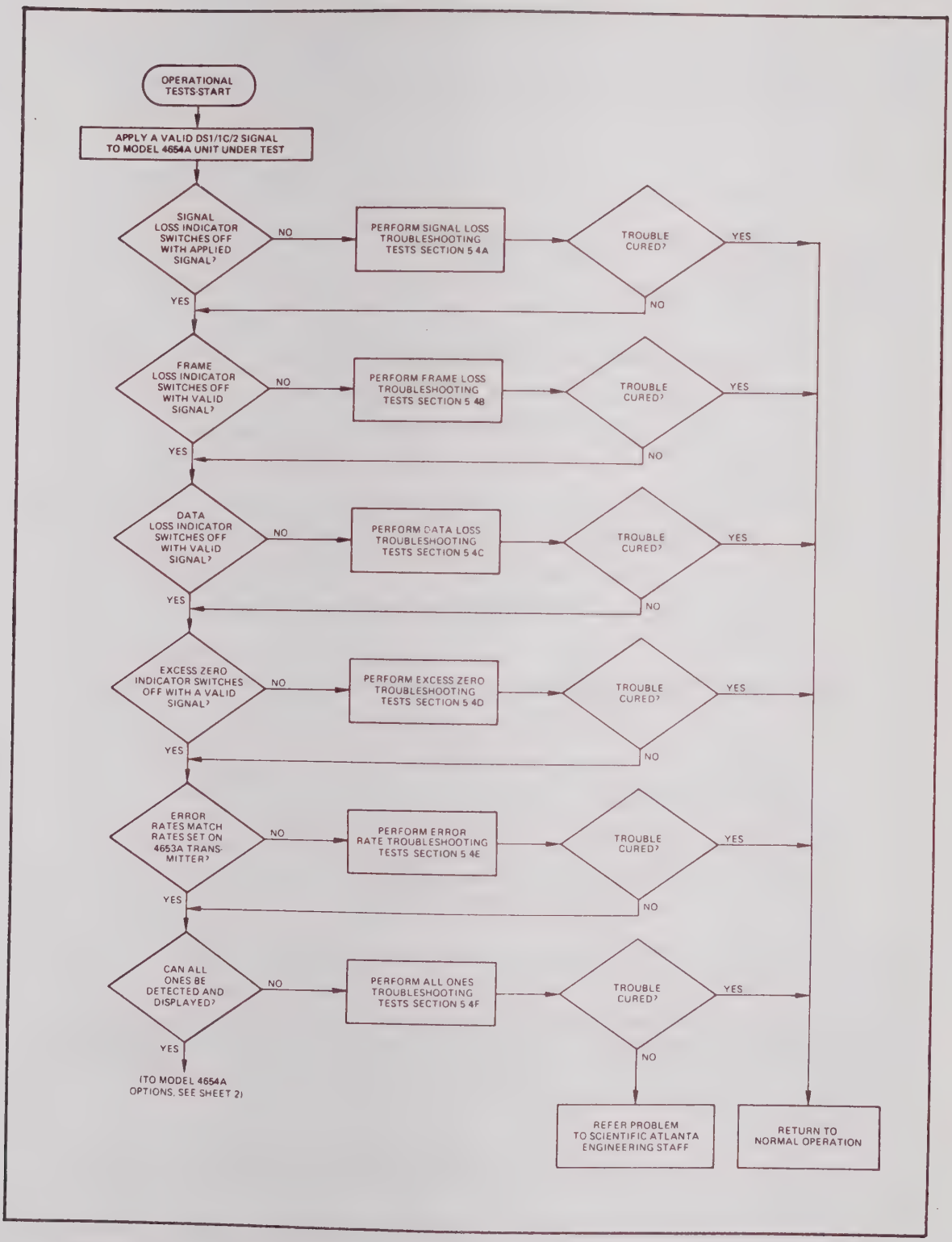


Figure 5.3. Model 4654A Analyzer Troubleshooting Flow Chart Using Operational Tests (Sheet 1 of 2)

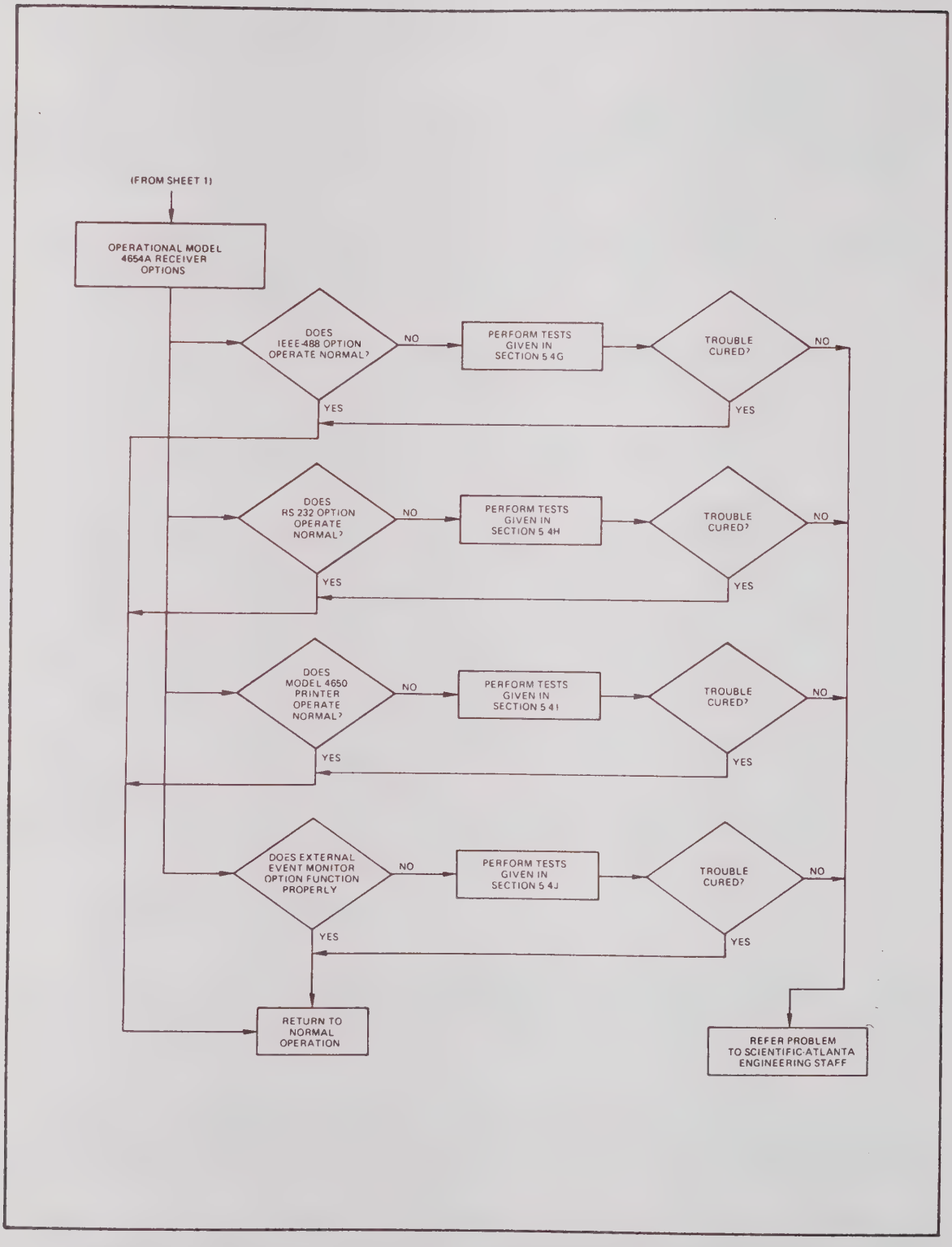


Figure 5.3. Model 4654A Analyzer Troubleshooting Flow Chart Using Operational Tests (Sheet 2 of 2)

- Apply a valid DS1/1C/2 signal and signal trace the signal loss line to the Error Counter PCB (A5) and through latch A5U13A. If the malfunction has not been identified up to this point of testing, replace PCB A10 with one known to be functioning properly.

B. FRAME LOSS FAILURE

If normal operation of a Model 4654A Analyzer is indicated as Section 5.4, but applying a valid DS1C or DS2 signal causes the FRAME LOSS indicator to illuminate, perform the following tests. Because of the complex circuitry required to recover and acknowledge the Framing signals, a malfunction of this nature is easier to troubleshoot when a second Model 4654A Analyzer, known to be functioning normally, is available. The following tests are started with two preliminary approaches to isolate a malfunction. Test 1 can be used if a normal operating second Model 4654A Analyzer is available; or Test 2 should be used if a second analyzer is not available. Perform either Test 1 or Test 2, whichever meets your requirements. If the malfunction continues to exist, then proceed with Test 3. Be sure to observe the applicable Notes.

TEST 1. ISOLATING A FRAME LOSS MALFUNCTION USING A SECOND 4654A ANALYZER

NOTE

If FRAMING cannot be acquired, observe if the Model 4654A Analyzer under test is counting Bipolar Violations for DS1, DS1C, or DS2 input. If Bipolar Violations are occurring, the indication is either a bad input or the improper extraction of data by circuits on the Clock Recovery PCB (A10).

- Verify that the valid DS1, DS1C, or DS2 signal has proper framing.
- Substitute individual PCBs from the troublefree Model 4654A Analyzer, one by one in the following sequence, and observe after each substitution if the malfunction continues to occur. This substitution routine may provide some isolation of the malfunction.

  a. Clock Recovery PCB (A10)
  b. Decoder/Detector PCB (A9)
  c. Frame Synchronizer PCB (A8)

d. DS1 Framing PCB (A7)
e. Bit Error Detector PCB (A6)
f. Error Counter PCB (A5)

- If trouble continues, go to Test 3.

TEST 2. ISOLATING A FRAME LOSS MALFUNCTION WITHOUT A SECOND 4654A ANALYZER

NOTE

If FRAMING cannot be acquired, observe if the Model 4654A Analyzer under test is counting Bipolar Violations for DS1, DS1C, or DS2 input. If Bipolar Violations are occurring, the indication is either a bad input or the improper extraction of data by circuits on the Clock Recovery PCB (A10).

- Verify operation of the Clock Recovery PCB (A10) by monitoring the + and - data output, the NRZ data output and Recovered Clock output A10J1-pins 32, 33, 34, and 35 respectively.
- Verify that the Clock Recovery PCB (A10) circuitry is phase locked by monitoring U10, pin 1 and TP-4 with a dual trace oscilloscope.
- Verify the operation, in DS2, of the B6ZS decoder on the Decoder/Detector PCB (A9), by monitoring the operation of U3, U4, U6, and U7.
- If trouble continues, go to Test 3.

TEST 3. ISOLATING A FRAME LOSS MALFUNCTION: ALL RECEIVERS

1. Determine whether the DS1 or the DS1C/DS2 signal has lost framing. On the Frame Synchronizer PCB (A8), check U5, pin 4. If this line is switching or continuously low, it indicates a DS1C/DS2 frame loss. If so, go to step 3. If the line is high, it indicates the DS1C/DS2 signal is frame locked. Now check, on the DS1 Framing PCB (A7), U1 pin 12. If this line is high, it indicates DS1 signal has lost frame lock. Go to step 2. If both DS1 and DS1C/DS2 PCBs indicate frame lock, go to step 4.
2. On the DS1 Framing PCB (A7), verify:
   - the presence of a DS1 rate clock at U2-1, U1-1, U3-2, U4-2, and U5-5
   - a pulse on U4-15 every 125 µs
   - a DS1 clock gapped every 125 µs on U5-1

- that U1-6 is low
- that data is present on U1-26
- that jumper P2 on J1 is on pins 1 and 2
- that U8-12 is low

3. On the Frame Synchronizer PCB (A8), verify:
   - that the F-Frame signal is in sync by observing a high on U8-15
   - that the M-Frame signal is in sync by observing a high on U1-9, and that the Frame Loss output is high at J1, pin 32
   - the Gapped Clock signal at J1, pin 40
4. Signal trace the Frame Loss signals from their sources on A7 and A8 to the Error Counter (A5). Verify:
   - that the signal on U15-18 is the same as on A7U2-12
   - that the signal on U13-6 is the same as on A8U5-4, if U13-6 is high, verify that U13-7 is low and that U15-4 is low.

C. DATA LOSS FAILURE

If normal operation of a Model 4654A Analyzer is indicated as in Section 5.4, but applying a valid DS1/1C/2 signal causes the DATA LOSS indicator to illuminate, perform the following tests. With these tests presume that SIGNAL LOSS and FRAME LOSS indicators are extinguished, indicating normal operation of these functions.

- Verify that both Clock and Data input signals are being applied to the Bit Error Detector PCB (A6) on connector A6J1, pins 40 (DATA) and 42 (CLOCK).
- If operating in Framed DS1C or DS2, verify that the channel stuff pulses from the Frame Synchronizer PCB (A8) are being applied to the Bit Error Detector (A6) on connector A6J1, pins 11, M, 12, and N. In DS1C, stuff pulses will appear only on pins 11 and M (Channels 1 and 2).

- Verify that the PRBS/NON PRBS line on connector A6J1, pin 32 has the correct sense for data type being input to the receiver (TTL-HI = PRBS).

- If operating in Framed DS1C or DS2, verify the channel count inputs from the Frame Synchronizer PCB (A8) are being applied to A6J1, pins 9 and 10.

- Verify the signal on the OUT-OF-SYNC line at connector A6J1. pin 25, and trace it to the Error Counter PCB (A5).

D. EXCESS ZERO

If normal operation of a Model 4654A Analyzer is indicated as in Section 5.4, but applying a valid signal input causes the EXCESS ZERO indicator to illuminate, perform the following tests. It is presumed that SIGNAL LOSS, FRAME LOSS, and DATA LOSS indicators are extinguished indicating normal operation of these functions.

- If operating in DS1 or DS1C, check the signal functions associated with components A9U9 and U10 on the Decoder/Detector PCB (A9). Verify the signal on U10, pin 15 (TTL-HI = EXCESS ZERO).

- If operating in DS2, check the signal functions associated with A9U5 and U8 and verify the signal on U8, pin 8 (TTL-LO = EXCESS ZERO).

- Verify the signal on connector A9J1, pin 31 (TTL-LO = EXCESS ZERO) and signal trace the line to the Error Counter PCB (A5).

E. ERROR RATE MISMATCH

Normally, a Model 4654A Analyzer faithfully tracks the generated error rate programmed into a Model 4653A Transmitter output signal. When a malfunction of this nature occurs, isolate the trouble using the following tests:

- Condition the output signal from a Model 4653A Transmitter to be DS2, PRBS with 1 x 10^{-3} BIT ERROR RATE. At the Model 4654A Analyzer under test, set for DS2, PRBS, and monitoring errors in all four channels, verify the presence of 80ns pulses with a 647us period on the Error Counter PCB (A5) at all four channel error inputs (A5J1, pins 37, s, 38, and t). If pulses cannot be verified, troubleshoot and repair the Bit Error Detector PCB (A6).

- On the Error Counter PCB (A5), signal trace errors through gates U11, selector U20 and counters U1, U2, U3, and U4.

- With Model 4653A Transmitter conditioned to output Bipolar Violations on DS2 at 1 x 10^{-3} error rate, verify the presence of 80ns pulses with a 158us period on the Decoder/Detector PCB (A9) on connector A9J1, pin r. Signal trace the pulses to the Error Counter PCB (A5) and through counters A5U5, U6, U7, and U8.

- Verify the operation of the 50,000 Bit Divider on the Decoder/Detector PCB (A9) and signal trace the signal to the Error Counter PCB (A5), and through A5U14C and to transistor A5Q1.

F. ALL ONES DETECTION MALFUNCTION

If a Model 4654A Analyzer fails to provide the ALL ONES display when the associated Model 4653A Transmitter is sending an all ones signal, isolate the malfunction rapidly using the schematics in Chapter 7 and the following tests:

NOTE

The ALL ONES indicator will flash when a bit error occurs and will not be illuminated for high bit error rates since the data is no longer "ALL ONES".

- Observe and verify the ALL ONES detection circuit operation on the Bit Error Detector PCB (A6). The ALL ONES detector consists of A6U9C and U25A.

- Signal trace the ALL ONES signal to the Error Counter PCB (A5) and through A5U14B.

G. OPTION 304208 IEEE-488 MALFUNCTION

Operating a Model 4654A Analyzer with the Optional IEEE-488 Interface is normally trouble-free. If a malfunction is suspected, perform the following tests:

- Refer to the Model 4654A Operator's Manual to verify or reset Address coding.

- Thoroughly check the flat cable interfacing between the rear panel connector and the IEEE-488 Interface PCB (A3).

H. OPTION 304209 RS-232C MALFUNCTION

Operating a Model 4654A Analyzer with the Optional RS-232C Interface, is normally trouble-free. If a malfunction is suspected, perform the following tests:

- Refer to the Model 4654A Operator's Manual to verify or reset the Baud Rate and other jumpers.
- Thoroughly check the flat cable interfacing between the rear panel connector and the RS-232C Interface PCB (A4).

I. OPTION 304210 EXTERNAL EVENT MONITOR MALFUNCTION

If a malfunction is suspected, perform the following tests at the unit. Verify:

- that input voltages appear at the J1 connector on the External Event Monitor/Memory PCB (A4).
- that each integrated circuit has power and ground on the appropriate pins.
- that pulses are present at U18 pins 13 and 14 and at U10 pin 3.
- that Q1 and Q2 turn on when they are selected.
- that a calibrated DVM is available if calibration of the front panel display is necessary. Then connect BOTH 4654A dc voltage inputs to any dc voltage source. Measuring this voltage at the source with the DVM, adjust R22 such that the two input voltages on the front panel agree with the DVM (or that any error is split between the two inputs).
- that U21, pins 17 and 18, toggle to reflect openings and closures of the two DRY CONTACT inputs. A "+99.98" or a "-99.98" indicates a failure of the A-to-D circuitry.

J. OPTION MODEL 4650 PRINTER MALFUNCTION

Operating a Model 4654A Analyzer with the Option Model 4650 Local Printer, is normally trouble-free. The printer mechanism and Control/ Drive Card are purchased items and available documentation has been included in Chapter 4. If a malfunction is suspected, perform the following tests:

- Refer to the Model 4654A Operator's Manual for information on how to cause the Local Printer to perform a Self-Test.
- Check for a marginal or bad component on the Local Printer I/O Interface PCB (A2). See Chapter 7 for the schematic diagram.

5.5 CALIBRATION

General. The following procedure describes adjustments which can be accomplished under normal conditions in a general electronic repair center. Adjustments to power supplies are provided in the first procedure.

A. TEST EQUIPMENT

The test equipment or its equivalent listed in Table 5.1 is required to perform the tests in this procedure. All test equipment must be calibrated and operating within its specified accuracy.

Table 5.1
Calibration Test Equipment

Description	Model	QTY	Manufacturer
DVM	3465A	1	Hewlett-Packard
Oscilloscope	475	1	Tektronix
Frequency/Period Counter	5315A	1	Hewlett-Packard
Probe, FET	P6201	2	Tektronix
Probe, 1M Ohms	P6106	2	Tektronix
DC Supply, 0-60V,9A	DCR609B	1	Sorenson

B. AC SOURCE POWER SUPPLY CALIBRATION

The Power Supply will be adjusted in the unit operating under loaded conditions. The Power Supply PCB (A12) is accessible by removing the top cover. With the ac Power OFF, extract the PCB and lay it on top of the chassis with cables attached. Use insulating material such as cardboard for safety. Switch the ac power ON. There are two adjustments on the Power Supply PCB: the +12V and the -12V Power Supplies. The adjustments are made as follows:

1. +12V POWER SUPPLY. Connect the DVM to TP-3 and TP-4 (COM). Adjust Potentiometer R12 until DVM reads +12.00 (±0.1)V.

2. -12V POWER SUPPLY. Connect the DVM to TP-6 and TP-4 (COM). Adjust Potentiometer R18 until DVM reads -12.00 (±0.1)V.

C. DC SOURCE POWER SUPPLY CALIBRATION

The DC Source Power Supply consists of two sections: The -5.2/-12.0V section and the +5.0/+12.0V section. Each section will be adjusted separately as follows:

-5.2/-12.0V Power Supply. Adjust the -5.2/-12.0V Power Supply PCB in the unit operating under loaded conditions. Remove the AC source and apply a -22V dc source to the "DC POWER" connector. The PCB's are accessible by removing the top cover. With the external dc power source OFF, extract the power supply PCB and lay it on top of the chassis with cables attached. Use insulating material such as cardboard for safety. Switch the dc power source ON.

1. Connect the DVM to monitor the -12.0V dc output between J1-3 (COM) and J1-9. Adjust variable resistor R7 counterclockwise two turns from the point it last affects the measured -12.0V dc output.

2. Connect the DVM to monitor the -5.2V dc output between J1-3 (COM) and J1-1. Adjust variable resistor R30 counterclockwise two turns from the point it last affects the measured -5.2V dc output.

3. Adjust variable resistor R23 to set the -5.2V dc output to -5.25V dc.

4. Adjust variable resistor R30 slowly clockwise to the point the DVM indication starts to decrease. Then adjust R30 counterclockwise two turns from this point.

5. Connect the DVM to monitor the -12.0V outputs between J1-3 and J1-9. The DVM should indicate -12.0 (±0.3)V dc. Adjust variable resistor R7 clockwise until the -12.0V dc outputs start to decrease, then adjust R7 counterclockwise two turns from this point.

6. This completes adjustment of the -5.2V/-12.0V Power Supply section.

+5.0V/+12.0V Power Supply. Adjust the +5.0V/+12.0V Power Supply PCB in the unit operating under loaded conditions. Remove the ac source and apply a -22V dc source to the "DC POWER" connector. The PCBs are accessible by removing the top cover. With the external power source OFF, extract the power supply PCB and lay it on top of the chassis with cables attached. Use insulating material such as cardboard for safety. Switch the dc power source ON.

1. Adjust variable resistors R1 and R17 three turns counterclockwise. Connect the DVM to monitor the +12.0V output between J1-5 (COM) and J1-1. Adjust variable resistor R4 until the DVM indicates +12.0 (±0.1)V dc.

2. Adjust variable resistor R1 slowly clockwise until the DVM indication starts to decrease, then adjust R1 slowly counterclockwise two turns.

3. Connect the DVM to monitor the +5.0V output between J1-5 (COM) and J1-3. Adjust variable resistor R20 slowly until the DVM indicates +5.1 (±0.1)V dc.

4. Adjust variable resistor R17 slowly clockwise until the DVM indication starts to decrease, then adjust R17 slowly counterclockwise two turns.

5. This completes the adjustment of the +5.0V/+12.0V Power Supply.

D. MODEL 4654A ANALYZER CALIBRATION

1. Clock Recovery Adjust

AGC Calibrate. With the Power OFF, install the Clock Recovery PCB (A10) on an extender card in slot A10. Switch the power ON and apply a DS1 level signal from a Model 4653A Transmitter set for "1010" data pattern. Connect the DVM to TP2 and adjust Level Set pot (R35) until the voltage at TP2 is as

close as possible to 7.0V. Connect the DVM to TP1 and adjust Max Level Set Pot (R19) for -3.75(±0.1)V. Use the oscilloscope with FET probe to observe the waveform at TP3. Be sure to ground the probe as near to TP3 as possible (to the shield) with a short ground directly to the ground ring of the FET probe. Adjust Level Set pot (R35) until the positive excursions of the waveform have a 250(±5)mV amplitude.

Lost Signal Set. Set the Model 4653A Transmitter and Model 4654A Analyzer for a DS1 signal and "1010" data pattern. With the DVM, observe the voltage on U13, pin 4, and adjust Lost Signal Set pot R55 until the DVM reads 5.0 (±0.1)V. Disconnect the signal cable to the analyzer and verify that Signal Loss is indicated. Reconnect the cable and verify that Signal Loss switches are off. Set both transmitter and analyzer for DS2-DSX and press the Reduce Level switch on the transmitter. Verify that no Signal Loss is indicated while Reduce Level is held depressed.

VCO Center Frequency Adjust. Connect the Frequency Counter to TP4. Apply any valid DS1 Bipolar signal to the Model 4654A Analyzer. Move jumper on TP8 from pins 1 and 2 to pins 2 and 3. Set up the analyzer for DS1 operation. Adjust Frequency Range pot (R60) until the Frequency Counter reads 1.544 MHz (±100 Hz). Replace TP8 jumper to pins 1 and 2 and verify phase lock by observing that the Frequency Counter reads 1.544 MHz (±10 Hz). CR6 should glow brightly to indicate phase lock.

DS1C and DS2 Frequency Adjust. Set both the Model 4653A Transmitter and Model 4654A Analyzer for a DS1C signal. Place TP8 jumper on pins 2 and 3. Adjust DS1C Frequency pot (R80) until the frequency at TP4 reads 3.152 MHz (±200 Hz). Set both transmitter and analyzer for a DS2 signal. Adjust DS2 Frequency pot (R62) until the frequency at TP4 reads 6.312 MHz (±200 Hz).

2. Real-Time Clock Calibrate

Setting of Clock Frequency. With power OFF, install the Real-Time Clock PCB (A2) to be tested on a card extender into slot A2. Apply ac power and monitor A2U16, pin 3 using the Frequency/Period Counter. Set the Counter to

measure a period with 1 us resolution. Adjust A2C1 to set the timer period to 500,000 (±5) us.

5.6 REGIONAL SERVICE CENTERS

Regional Service Centers capable of performing periodic maintenance and providing assistance associated with the Model 4654A Error Rate Analyzer and other Scientific-Atlanta equipment are listed below. Service Assistance for areas not listed can be provided through the Scientific-Atlanta Field Service Center, 4357 Park Drive, Suite G, Atlanta, Georgia 30093; TEL: 404-925-5122; TWX: 810-766-4912; TELEX: 542898.

NORTH AMERICAN REGIONAL SERVICE CENTERS

Northeastern Regional Office
149 Middlesex Turnpike
Burlington, Massachusetts 01803
Tel: 617-272-1256

Washington D.C. Regional Office
Washington Business Park
5100-J Philadelphia Way
Tanham, Maryland 20706
Tel: 301-577-4830

Mid Atlantic Regional Office
2100 Route 208
Fair Lawn, New Jersey 07410
Tel: 201-791-8777

Southeastern Regional Office
4025 Pleasantdale Road
Atlanta, Georgia 30340
Tel: 404-449-2021

Florida Regional Office
P.O. Box 2143
841 West Emmett St.
Kissimmee, Florida 32741
Tel: 305-846-0055

Midwest Regional Office
Fidelity Bldg., Suite 306
11550 N. Meridian
Carmel, Indiana 46032
Tel: 317-846-7142

Chicago Service Center
621 East Butterfield Rd., Suite 219
Lombard, Illinois 60148
Tel: 312-963-6375

Southwestern Regional Office
1237 Executive Drive, East
Richardson, Texas 75081
Tel: 214-238-1116

Denver Service Center
103 Inverness Dr. East
Inglewood, Colorado 80112
Tel: 303-790-0585

So. California Regional Office
P.O. Box 2668
10039 Pioneer Boulevard
Santa Fe Springs, California 90670
Tel: 213-949-9411

NORTH AMERICAN REGIONAL SERVICE CENTERS - (Continued)

No. California Regional Office
3375 Scott Boulevard, Suite 304
Santa Clara, California 95051
Tel: 408-496-1040

INTERNATIONAL SERVICE CENTERS

CANADA
Scientific-Atlanta, Ltd.
1640 Bonhill Road
Unit 6
Mississauga, Ontario L5T1C8
Tel: 416-677-6555
Telex: 06983600

ENGLAND
Scientific-Atlanta, Ltd.
Horton Manor
Stanwell Road, Horton
Slough SL3 9PA, England
Tel: 44.2812-3211
Telex: 849406

FRANCE
Scientific-Atlanta S.A.
4 Avenue Gabriel Peri
78360 Montesson
France
Tel: 33.1.9769191
Telex: 646385

GERMANY
Scientific-Atlanta GmbH
Albert Schweitzerstrasse 66/3
D8000 Munich 83, Germany
Tel: 49.8967.1044
Telex: 5212264

ITALY
Scientific-Atlanta, S.p.A.
Via Benedetto Croce 19
00142 Rome, Italy
Tel 39.06.5420244
Telex: 621441

CHAPTER 6
PARTS LISTS

6.1 GENERAL

The parts lists for the Model 4654A Error Rate Analyzer are included in this chapter. Special modifications, if any, are enclosed in the envelope in the rear of this manual.

6.2 EXPLANATION OF COLUMN HEADINGS

REF. DESIG. This identifies the assigned reference designation applicable to a system or equipment sub-unit having a separate prefix and arrangement of individual components.

SCIENTIFIC-ATLANTA (S-A) PART NO. A five or six digit number assigned by Scientific-Atlanta to the specific part for identification and correct replacement ordering information.

DESCRIPTION. A brief electrical and/or mechanical description of the component.

FSCM. The proper Federal Supply Code for Manufacturers is entered in this column. The code numbers are from the Federal Supply code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) in effect as of the publication date of this manual.

VENDOR PART NO. The number assigned to a part by an outside supplying manufacturer is listed in this column.

6.3 ORDERING PARTS

When ordering parts from Scientific-Atlanta, always include the Scientific-Atlanta part number, the part description, the unit name, the unit serial number, the subassembly name, the part manufacturer (FSCM), and the manufacturer's part number.

6.4 PARTS SUBSTITUTION

Common components may differ from those identified in the parts list. This difference is due to the substitution of a more current part during assembly. When this occurs, the replacement may be either a part identical to the type removed or a part meeting the description given in the parts lists.

MODEL 4654A TEST SET ANALYZER

	Comp Desig	S-A Part No.	Description	Page
(1)	A1	314130	8080 CPU PWB Assembly	6-5
(2)	A2	316190	Real-Time Clock PWB Assembly	6-7
	A4	313106	Memory PWB Assembly	6-9
	A5	304160	Error Counter PWB Assembly	6-10
	A6	304157	Bit Error Detector PWB Assembly	6-12
	A7	304151	DS1 Framing PWB Assembly	6-14
	A8	252825	Frame Sync. PWB Assembly	6-15
	A9	252822	Decorder/Detector PWB Assembly	6-16
	A10	252819	Clock Recovery PWB Assembly	6-17
	A11	304154	Motherboard PWB Assembly	6-20
	*A12	252725	Power Supply PWB Assembly	6-21
	**A12	220905	-5.2V/-12V Power Supply PWB Assembly	6-23
	**A13	220917	+5V/+12V Power Supply PWB Assembly	6-26
	A14	304142	Front Panel Assembly	6-28
	A14A1	304145	Front Panel PWB Assembly	6-29
	A14A2	304169	Front Panel Display PWB Assembly	6-30
	A14A3	304171	Front Panel Indicator PWB Assembly	6-31
	A14A4	304167	Front Panel I/O PWB Assembly	6-32
	*A15	304183	Rear Panel Assembly	6-34
	**A15	304184	Rear Panel Assembly	6-35
	**A15A1	252781	Rectifier and Filter PWB Assembly	6-36
		*252751	Power Wiring Harness	6-37
		**220947	Power Wiring Harness	6-37
		252791	Cable Assembly, Demux Cont I/O	6-37
		*220983	Cable Assembly, Local Printer Interface	6-37
		304208	IEEE-488 Interface Option PWB Assy.	6-38
		304209	RS-232C Interface Option PWB Assy.	6-41
		304210	External Monitor Option	6-43

*AC Version Only
**AC/DC Version Only

(1) (2) SEE PAGE 6-4

MODEL 4654 TEST SET ANALYZER

Comp Desig	S-A Part No.	Description	Page
	221020	Optional Printer Assembly	6-46
	220994	Optional Printer Assembly Model 4650	6-46
	221002	Optional Printer I/O Interface PWB Assembly	6-47
	220999	Optional Printer Assembly Flex PWB Assy.	6-47
	304178	Accessory Kit	6-48
	304125	Service Accessory Kit	6-48

(1)

REF DESIG	PART NUMBER	*SERIAL NUMBER FROM	TO
A1	313220	1	46
A1	314130	47	121
A1	315276	122	206
A1	316186	207	

(2)

REF DESIG	PART NUMBER	*SERIAL NUMBER FROM	TO
A2	313103	1	228
A2	316190	229	

* SERIAL NUMBER IS APPROXIMATE

ANALYZER 8080 CPU ASSEMBLY - 316186 (1)
REF DESIGNATION PREFIX: 4654A-A1

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
1	252870	PWB SUBASSEMBLY, CPU		
(1)-2	0316187	EPROM AND LABEL ASSY CPU 4654A		
U1	0086519	IC MICROPROCESSOR 8-BIT NMOS IMPROVED	D8080	
U3	0086641	IC PERIPHERAL INTERFACE PROGRAMMABLE	D8255A	
		Subassembly - 252870		
C1	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C2	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C3	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C4	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C5	0086013	CAPACITR 22 MF 25V SOLID TANT POL 10%	T362C226K025AS	
C6	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C7	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C8	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C9	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C10	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C11	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C12	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C13	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C14	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C15	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C16	0078600	NOT ASSIGNED		
C17	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C18	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C19	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C20	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C21	0077512	CAPACITR 24 PF 500V SILVER MICA 5%	CD15ED240J03	14655
C22	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C23	0079172	CAPACITR 5.5-18 PF MIN CER DISC PC MT	538-011 A 5.5-18	72982
C24	0070518	CAPACITR 100 PF 1KV CER DISC S3N 10%	DD-101	71590
C25	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
J2	0171549	CONN HEADER DBL ROW RT ANGLE 50-PIN LTCH	3433-1202	
J7	0087366	CONN HEADER SGL ROW STRAIGHT 3-PIN PC	87220-3	
L1	0078046	INDUCTOR 3.3 UH SUBMIN UNSHLD 10%	IR-2	91637
L2	0081977	CORE BEAD FERRITE 7D .260X.125X.375L	57-1555	78488
P2	0086884	JUMPER FEMALE INSULATED .10 SPACING	65474-004	
Q1	0083712	TRANSSTR 2N5019 FET P-CHNL JUNC	2N5019	32293
R1	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R3	0071887	RESISTOR 100 OHM 1/4W 10% COMP	RCR07G101KS	01121
R4	0071993	RESISTOR 3.9K OHM 1/4W 10% COMP	RCR07G392KS	01121
R5	0072002	RESISTOR 4.7K OHM 1/4W 10% COMP	RCR07G472KS	01121
R11	0071951	RESISTOR 1.0K OHM 1/4W 10% COMP	RCR07G102KS	01121
R12	0072002	RESISTOR 4.7K OHM 1/4W 10% COMP	RCR07G472KS	01121
R13	0072113	RESISTOR 100K OHM 1/4W 10% COMP	RCR07G104KS	01121
R14	0072077	RESISTOR 47K OHM 1/4W 10% COMP	RCR07G473KS	01121
R15	0071951	RESISTOR 1.0K OHM 1/4W 10% COMP	RCR07G102KS	01121
R16	0072002	RESISTOR 4.7K OHM 1/4W 10% COMP	RCR07G472KS	01121
R17	0072002	RESISTOR 4.7K OHM 1/4W 10% COMP	RCR07G472KS	01121
R18	0071951	RESISTOR 1.0K OHM 1/4W 10% COMP	RCR07G102KS	01121
U1	0084000	VARIES WITH MODEL,SEE HIGHER ASSY FOR PN	PER S A DWG	
U3	0084000	VARIES WITH MODEL,SEE HIGHER ASSY FOR PN	PER S A DWG	
U2	0085188	IC CONTROLLER AND BUS DRIVER FOR 8080A	D8228	
U5	0086692	IC TTL GATE INVERTER HEX	SN74LS05J	
U6	0085187	IC CLOCK GENERATOR FOR 8080A CPU	D8224	
U7	0084281	IC TTL GATE INVERTER HEX	SN74LS04N	01295
U9	0085950	IC TTL LATCH 8-BIT TRANSPARENT 3-STATE	SN74LS373N	
U10	0085950	IC TTL LATCH 8-BIT TRANSPARENT 3-STATE	SN74LS373N	
U11	0085946	IC TTL GATE NAND 3-IN TRIPLE	SN74LS10N	
U12	0085943	IC TTL DECODER 3-BIT TO 1 OF 8	SN74LS138N	
U13	0084278	IC TTL GATE NAND 4-IN DUAL	SN74LS20N	01295
U14	0171581	IC CMOS RAM 2048X8 200 NS STATIC	HM6116L-4	

(1) SEE PAGE 6-6

Subassembly - 252870 (continued)

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
U15	0078600	NOT ASSIGNED	FOR ENG ONLY	
U16	0086898	IC BUS TRANSCVR 8-BIT	SN74LS245N	
U17	0084282	IC TTL GATE AND 2-IN QUAD	SN74LS08N	01295
U18	0084279	IC TTL GATE NAND 2-IN QUAD	SN74LS00N	01295
U20	0087092	RESISTOR NETWORK 9 22K OHM 2% 10 SIP	4310R-101-223	
U21	0087092	RESISTOR NETWORK 9 22K OHM 2% 10 SIP	4310R-101-223	
U22	0087091	RESISTOR NETWORK 9 1K OHM 2% 10 SIP	4310R-101-102	
U23	0087092	RESISTOR NETWORK 9 22K OHM 2% 10 SIP	4310R-101-223	
U24	0087092	RESISTOR NETWORK 9 22K OHM 2% 10 SIP	4310R-101-223	
U25	0087092	RESISTOR NETWORK 9 22K OHM 2% 10 SIP	4310R-101-223	
U26	0087091	RESISTOR NETWORK 9 1K OHM 2% 10 SIP	4310R-101-102	
XU1	0086653	SOCKET 40 PIN DIP PC MT	ICT-406-S-T	
XU2	0086652	SOCKET 28 PIN DIP PC MT	ICT-286-S-TG30	
XU3	0086653	SOCKET 40 PIN DIP PC MT	ICT-406-S-T	
XU4	0086652	SOCKET 28 PIN DIP PC MT	ICT-286-S-TG30	
XU5	0086648	SOCKET 14 PIN DIP PC MT	ICT-143-S-T	
XU6	0086649	SOCKET 16 PIN DIP PC MT	ICT-163-S-T	
XU7	0086648	SOCKET 14 PIN DIP PC MT	ICT-143-S-T	
XU9	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU10	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU11	0086648	SOCKET 14 PIN DIP PC MT	ICT-143-S-T	
XU12	0086649	SOCKET 16 PIN DIP PC MT	ICT-163-S-T	
XU13	0086648	SOCKET 14 PIN DIP PC MT	ICT-143-S-T	
XU14	0086651	SOCKET 24 PIN DIP PC MT	ICT-246-S-T	
XU16	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU17	0086648	SOCKET 14 PIN DIP PC MT	ICT-143-S-T	
XU18	0086648	SOCKET 14 PIN DIP PC MT	ICT-143-S-T	
XU19	0086652	SOCKET 28 PIN DIP PC MT	ICT-286-S-TG30	
Y1	0087940	CRYSTAL 18.432 MHZ .0025% SERIES MODE	SCM 18 HOLDER	

(1)

*SERIAL NUMBER		PWB ASSEMBLY NUMBER	ITEM 2 PART NUMBER
FROM	TO		
1	46	313220	313221
47	121	314130	314129
122	206	315276	315277
207		316186	316187

* SERIAL NUMBER IS APPROXIMATE

ANALYZER REAL-TIME CLOCK ASSEMBLY - 316190 (1)
REF DESIGNATION PREFIX: 4654A-A2

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
1	252877	PWB SUBASSEMBLY, REAL-TIME CLOCK		
(1) -2	0316191	EPROM AND LABEL ASSY RTC 4654A		
		Subassembly - 252877		
BT1	0316545	BATTERY,NICAD,PC MOUNT 3.6V		
C1	0083649	CAPACITR 7-25 PF MIN CER DISC PC MT	538-011-B-7-25	72982
C2	0080142	CAPACITR 20 PF 500V SILVER MICA 5%	CD15ED200J03	14655
C3	0078600	NOT ASSIGNED	FOR ENG ONLY	
C4	0070525	CAPACITR 150 PF 1KV CER DISC S3N 10%	DD-151	71590
C5	0084221	CAPACITR .022 MF 100V CER MONO X7R 10%	8131-100-X7R-223K	72982
C6	0081808	CAPACITR 2.2 MF 50V CER MONO 20%	8141-050-651-225M	72982
C7	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C8	0035656	CAPACITR 100 MF 20V SOLID TANT POL 10%	T362D107K020AS	05397
C9	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C10	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C11	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C12	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C13	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C14	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C15	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C16	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C17	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C18	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C19	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C20	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C21	0035654	CAPACITR 10 MF 25V SOLID TANT POL 10%	T362B106K025AS	05397
C22	0070470	CAPACITR 10 PF 500V SILVER MICA 5%	CD15CD100J03	14655
CR1	0083983	DIODE 1N5226B SI ZEN 3.3V 5% .5W	1N5226B	13715
CR2	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR3	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
J2	0087229	CONN HEADER SGL ROW STRAIGHT 2-PIN PC	87220-2	
J4	0087366	CONN HEADER SGL ROW STRAIGHT 3-PIN PC	87220-3	
J6	0078600	NOT ASSIGNED	FOR ENG ONLY	
J8	0087229	CONN HEADER SGL ROW STRAIGHT 2-PIN PC	87220-2	
P2	0086884	JUMPER FEMALE INSULATED .10 SPACING	65474-004	
P3	0086884	JUMPER FEMALE INSULATED .10 SPACING	65474-004	
P4	0078600	NOT ASSIGNED	FOR ENG ONLY	
P5	0086884	JUMPER FEMALE INSULATED .10 SPACING	65474-004	
Q1	0077147	TRANSSTR 2N3947 NPN SIL	2N3947	04713
Q2	0077147	TRANSSTR 2N3947 NPN SIL	2N3947	04713
Q3	0077147	TRANSSTR 2N3947 NPN SIL	2N3947	04713
Q4	0077147	TRANSSTR 2N3947 NPN SIL	2N3947	04713
Q5	0077148	TRANSSTR 2N3251 PNP SIL	2N3251	04713
Q6	0077147	TRANSSTR 2N3947 NPN SIL	2N3947	04713
Q7	0077148	TRANSSTR 2N3251 PNP SIL	2N3251	04713
Q8	0077147	TRANSSTR 2N3947 NPN SIL	2N3947	04713
R1	0071951	RESISTOR 1.0K OHM 1/4W 10% COMP	RCR07G102KS	01121
R2	0071977	RESISTOR 2.2K OHM 1/4W 10% COMP	RCR07G222KS	01121
R3	0071977	RESISTOR 2.2K OHM 1/4W 10% COMP	RCR07G222KS	01121
R5	0071897	RESISTOR 150 OHM 1/4W 10% COMP	RCR07G151KS	01121
R7	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R8	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R9	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R11	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R12	0072165	RESISTOR 470K OHM 1/4W 10% COMP	RCR07G474KS	01121
R13	0081341	RESISTOR 22 MEG 1/4W 10% COMP	RCR07G226KS	01121
R14	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R17	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R18	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R19	0072014	RESISTOR 6.8K OHM 1/4W 10% COMP	RCR07G682KS	01121
R21	0072153	RESISTOR 330K OHM 1/4W 10% COMP	RCR07G334KS	01121
R22	0072189	RESISTOR 1.0 MEG 1/4W 10% COMP	RCR07G105KS	01121

(1) SEE PAGE 6-8

Subassembly - 252877 (continued)

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
R23	0072147	RESISTOR 270K OHM 1/4W 10% COMP	RCR07G274KS	01121
R24	0072002	RESISTOR 4.7K OHM 1/4W 10% COMP	RCR07G472KS	01121
R26	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R27	0072077	RESISTOR 47K OHM 1/4W 10% COMP	RCR07G473KS	01121
R28	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R29	0072054	RESISTOR 22K OHM 1/4W 10% COMP	RCR07G223KS	01121
R30	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R31	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R32	0071977	RESISTOR 2.2K OHM 1/4W 10% COMP	RCR07G222KS	01121
R33	0071951	RESISTOR 1.0K OHM 1/4W 10% COMP	RCR07G102KS	01121
R34	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R35	0074675	RESISTOR 100 OHM 1/4W 5% COMP	RCR07G101JS	01121
R36	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R37	0072002	RESISTOR 4.7K OHM 1/4W 10% COMP	RCR07G472KS	01121
R38	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R39	0071977	RESISTOR 2.2K OHM 1/4W 10% COMP	RCR07G222KS	01121
R40	0071977	RESISTOR 2.2K OHM 1/4W 10% COMP	RCR07G222KS	01121
R41	0071977	RESISTOR 2.2K OHM 1/4W 10% COMP	RCR07G222KS	01121
R42	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R43	0072002	RESISTOR 4.7K OHM 1/4W 10% COMP	RCR07G472KS	01121
R44	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R45	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
RT1	0083617	THERMSTR 100 OHM DISC 25 DEG C 10%	FD21J1	15801
U1	0170303	IC CLOCK CALENDAR FOR MICROS CMOS	MM58167N	
U2	0083017	IC CMOS GATE NOR 2-IN QUAD	MC14001BCL	04713
U3	0086646	IC TTL DECODER 2-BIT TO 1 OF 4 DUAL	SN74LS139N	
U4	0084279	IC TTL GATE NAND 2-IN QUAD	SN74LS00N	01295
U5	0084280	IC TTL GATE NOR 2-IN QUAD	SN74LS02N	01295
U6	0086647	IC TTL GATE AND 2-IN QUAD OPEN COL	SN74LS09N	
U7	0170309	IC CMOS DECODER BCD TO DEC	MM74C42J	
U8	0085943	IC TTL DECODER 3-BIT TO 1 OF 8	SN74LS138N	
U9	0171581	IC CMOS RAM 2048X8 200 NS STATIC	HM6116L-4	
U10	0078600	NOT ASSIGNED	FOR ENG ONLY	
U13	0085949	IC TTL BUFFER OCTAL 3-STATE	SN74LS244N	
U14	0086898	IC BUS TRANSCVR 8-BIT	SN74LS245N	
U15	0084509	IC TTL MULTIPLEXER 8-BIT/1-CHNL TO1 3STE	SN74LS251N	01295
U16	0170205	IC CMOS COUNTER 14 STAGE BIN	CD4060AF	
U17	0084960	IC TTL COUNTER BIN 35-MHZ	SN74LS161AN	01295
U18	0087804	IC TTL COUNTER BIN 35-MHZ DUAL	SN74LS393J	
U20	0087889	IC TTL FLIP-FLOP TYPE-D OCTAL 3-STATE	SN74LS374N	
U21	0084283	IC TTL FLIP-FLOP TYPE-D DUAL	SN74LS74AN	01295
U22	0084281	IC TTL GATE INVERTER HEX	SN74LS04N	01295
U23	0084283	IC TTL FLIP-FLOP TYPE-D DUAL	SN74LS74AN	01295
U24	0087879	IC CMOS MULTI MONO RETRIG DUAL PREC	MC14538BCL	
U25	0087271	IC TIMER 8L-DIP	LM3905N	
XU1	0086651	SOCKET 24 PIN DIP PC MT	ICT-246-S-T	
XU2	0086648	SOCKET 14 PIN DIP PC MT	ICT-143-S-T	
XU7	0086649	SOCKET 16 PIN DIP PC MT	ICT-163-S-T	
XU9	0086651	SOCKET 24 PIN DIP PC MT	ICT-246-S-T	
XU10	0078600	NOT ASSIGNED	FOR ENG ONLY	
XU11	0086652	SOCKET 28 PIN DIP PC MT	ICT-286-S-TG30	
XU12	0086652	SOCKET 28 PIN DIP PC MT	ICT-286-S-TG30	
XU13	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU14	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU16	0086649	SOCKET 16 PIN DIP PC MT	ICT-163-S-T	
XU20	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU24	0086649	SOCKET 16 PIN DIP PC MT	ICT-163-S-T	
XU25	0087983	SOCKET 8 PIN DIP PC MT	1CT-083-S-T	
Y1	0170302	CRYSTAL 32.768 KHZ .003% PARALLEL RES	CX-1V-32.768KHZ CAL	

(1)

*SERIAL NUMBER FROM	*SERIAL NUMBER TO	PWB ASSEMBLY NUMBER	ITEM 2 PART NUMBER
1	228	313103	313104
229		316190	316191

ANALYZER MEMORY ASSEMBLY - 313106
REF DESIGNATION PREFIX: 4654A-A4

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
1	0304123	PWB SUBASSEMBLY, MEMORY MDL 4654A		
2	0313107	EPROM & LABEL ASY MEMORY 4654A		
		Subassembly - 304123		
C1	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C2	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C3	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C4	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C5	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C8	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C10	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C11	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C12	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C15	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
U1	0085943	IC TTL DECODER 3-BIT TO 1 OF 8	SN74LS138N	
U2	0171581	IC CMOS RAM 2048X8 200 NS STATIC	HM6116L-4	
U4	0084285	IC TTL GATE OR 2-IN QUAD	SN74LS32N	01295
U5	0086646	IC TTL DECODER 2-BIT TO 1 OF 4 DUAL	SN74LS139N	
U6	0084282	IC TTL GATE AND 2-IN QUAD	SN74LS08N	01295
U7	0086898	IC BUS TRANSCVR 8-BIT	SN74LS245N	
U8	0086646	IC TTL DECODER 2-BIT TO 1 OF 4 DUAL	SN74LS139N	
U9	0085948	IC TTL FLIP-FLOP TYPE-D OCTAL	SN74LS377N	
XU2	0086651	SOCKET 24 PIN DIP PC MT	ICT-246-S-T	
XU3	0086652	SOCKET 28 PIN DIP PC MT	ICT-286-S-TG30	
XU7	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU9	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	

ANALYZER ERROR COUNTER ASSEMBLY - 304160
REF DESIGNATION PREFIX: 4654A-A5

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
1	0304159	PWB ERROR COUNTER MDL 4654A		
C1	0079003	CAPACITR 100 MF 16V	500D107G016DC7	80183
C2	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C3	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C4	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C5	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C6	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C7	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C8	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C9	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C10	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C11	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C12	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C13	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C14	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
J1	0089546	CONN HEADER DBL ROW STRAIGHT 8-PIN PC	87227-4	
P2	0086884	JUMPER FEMALE INSULATED .10 SPACING	65474-004	
P3	0086884	JUMPER FEMALE INSULATED .10 SPACING	65474-004	
P4	0086884	JUMPER FEMALE INSULATED .10 SPACING	65474-004	
P5	0086884	JUMPER FEMALE INSULATED .10 SPACING	65474-004	
Q1	007714	TRANSSTR 2N3947 NPN SIL	2N3947	04713
R1	0071951	RESISTOR 1.0K OHM 1/4W 10% COMP	RCR07G102KS	01121
R2	0078600	NOT ASSIGNED	FOR ENG ONLY	
R3	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R4	0072002	RESISTOR 4.7K OHM 1/4W 10% COMP	RCR07G472KS	01121
R5	0071938	RESISTOR 680 OHM 1/4W 10% COMP	RCR07G681KS	01121
R6	0071938	RESISTOR 680 OHM 1/4W 10% COMP	RCR07G681KS	01121
R7	0071951	RESISTOR 1.0K OHM 1/4W 10% COMP	RCR07G102KS	01121
R8	0076274	RESISTOR 18 OHM 1/4W 10% COMP	RCR07G180KS	01121
U1	0171534	IC TTL COUNTER BIN 20-MHZ MUX 3-STATE	SN74LS693N	
U2	0171534	IC TTL COUNTER BIN 20-MHZ MUX 3-STATE	SN74LS693N	
U3	0171534	IC TTL COUNTER BIN 20-MHZ MUX 3-STATE	SN74LS693N	
U4	0171534	IC TTL COUNTER BIN 20-MHZ MUX 3-STATE	SN74LS693N	
U5	0171534	IC TTL COUNTER BIN 20-MHZ MUX 3-STATE	SN74LS693N	
U6	0171534	IC TTL COUNTER BIN 20-MHZ MUX 3-STATE	SN74LS693N	
U7	0171534	IC TTL COUNTER BIN 20-MHZ MUX 3-STATE	SN74LS693N	
U8	0171534	IC TTL COUNTER BIN 20-MHZ MUX 3-STATE	SN74LS693N	
U9	0085943	IC TTL DECODER 3-BIT TO 1 OF 8	SN74LS138N	
U10	0086898	IC BUS TRANSCVR 8-BIT	SN74LS245N	
U11	0084285	IC TTL GATE OR 2-IN QUAD	SN74LS32N	01295
U12	0084281	IC TTL GATE INVERTER HEX	SN74LS04N	01295
U13	0087073	IC TTL LATCH NAND R/S QUAD	SN74LS279N	
U14	0087073	IC TTL LATCH NAND R/S QUAD	SN74LS279N	
U15	0087889	IC TTL FLIP-FLOP TYPE-D OCTAL 3-STATE	SN74LS374N	
U16	0085949	IC TTL BUFFER OCTAL 3-STATE	SN74LS244N	
U17	0085948	IC TTL FLIP-FLOP TYPE-D OCTAL	SN74LS377N	
U18	0085948	IC TTL FLIP-FLOP TYPE-D OCTAL	SN74LS377N	
U19	0084285	IC TTL GATE OR 2-IN QUAD	SN74LS32N	01295
U20	0087686	IC TTL MULTIPLEXER 8-BIT/1-CHNL TO 1	SN74LS151J	
U21	0084281	IC TTL GATE INVERTER HEX	SN74LS04N	01295
U22	0089423	IC TIL GATE NAND 8-IN	SN74LS30N	
U23	0084279	IC TTL GATE NAND 2-IN QUAD	SN74LS00N	01295
U24	0087694	IC TTL BUFFER NAND 4-IN DUAL	SN74S140J	
U25	0085945	IC TTL BUFFER HEX 3-STATE	SN74LS365AN	
U26	0089590	RESISTOR NETWORK 5 4.7K OHM 2% 6 SIP	4306R-101-472	
U27	0089590	RESISTOR NETWORK 5 4.7K OHM 2% 6 SIP	4306R-101-472	
U28	0087086	RESISTOR NETWORK 7 4.7K OHM 2% 8 SIP	4308R-101-472	
XU1	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU2	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU3	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU4	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU5	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU6	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	

ANALYZER ERROR COUNTER ASSEMBLY - 304160 (continued)

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
XU7	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU8	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU10	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU15	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU16	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU17	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU18	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU25	0086649	SOCKET 16 PIN DIP PC MT	ICT-163-S-T	

ANALYZER BIT ERROR DETECTOR ASSEMBLY - 304157
REF DESIGNATION PREFIX: 4654A-A6

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
1	0313881	PWB ANALYZER BIT ERROR DETECTOR		
C1	0035654	CAPACITR 10 MF 25V SOLID TANT POL 10%	T362B106K025AS	05397
C2	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C3	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C4	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C5	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C6	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C7	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C8	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C9	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C10	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C11	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C12	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C13	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C14	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C15	0082952	CAPACITR 220 PF 1KV CER DISC Z5F 10%	DD-221	71590
C16	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C17	0081826	CAPACITR 110 PF 100V SILVER MICA 2%	D151C111G03	53021
C18	0081826	CAPACITR 110 PF 100V SILVER MICA 2%	D151C111G03	53021
C19	0081826	CAPACITR 110 PF 100V SILVER MICA 2%	D151C111G03	53021
C20	0081826	CAPACITR 110 PF 100V SILVER MICA 2%	D151C111G03	53021
C21	0070541	CAPACITR 500 PF 1KV CER DISC Z5F 10%	DD 501	71590
C22	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C23	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103	72982
C24	0070540	CAPACITR 470 PF 1KV CER DISC Z5F 10%	DD-471	71590
C25	0070540	CAPACITR 470 PF 1KV CER DISC Z5F 10%	DD-471	71590
C26	0070540	CAPACITR 470 PF 1KV CER DISC Z5F 10%	DD-471	71590
C27	0070540	CAPACITR 470 PF 1KV CER DISC Z5F 10%	DD-471	71590
J1	0087229	CONN HEADER SGL ROW STRAIGHT 2-PIN PC	87220-2	
J2	0087366	CONN HEADER SGL ROW STRAIGHT 3-PIN PC	87220-3	
J3	0087229	CONN HEADER SGL ROW STRAIGHT 2-PIN PC	87220-2	
P2	0086884	JUMPER FEMALE INSULATED .10 SPACING	65474-004	
P3	0086884	JUMPER FEMALE INSULATED .10 SPACING	65474-004	
R1	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R2	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R3	0072138	RESISTOR 220K OHM 1/4W 10% COMP	RCR07G224KS	01121
R4	0078600	NOT ASSIGNED	FOR ENG ONLY	
TP1	0082909	TERMINAL PRESS MT DISCONNECT .058 PIN	60599-1	00779
U1	0084281	IC TTL GATE INVERTER HEX	SN74LS04N	01295
U2	0087981	IC TTL BUFFER QUAD 3-STATE	SN74LS125N	
U3	0087689	IC TTL REGISTER SHIFT 8-BIT S-IN P-OUT	SN74LS164J	
U4	0087689	IC TTL REGISTER SHIFT 8-BIT S-IN P-OUT	SN74LS164J	
U5	0087689	IC TTL REGISTER SHIFT 8-BIT S-IN P-OUT	SN74LS164J	
U6	0084277	IC TTL GATE EX-OR 2-IN QUAD	SN74LS86N	01295
U7	0084284	IC TTL GATE NOR 3-IN TRIPLE	SN74LS27N	01295
U8	0084284	IC TTL GATE NOR 3-IN TRIPLE	SN74LS27N	01295
U9	0084284	IC TTL GATE NOR 3-IN TRIPLE	SN74LS27N	01295
U10	0087488	IC TTL GATE AND 3-IN TRIPLE	SN74LS11N	
U11	0087804	IC TTL COUNTER BIN 35-MHZ DUAL	SN74LS393J	
U12	0087233	RESISTOR NETWORK 7 1K OHM 2% 8 51P	4308R-101-102	
U13	0084960	IC TTL COUNTER BIN 35-MHZ	SN74LS161AN	01295
U14	0087073	IC TTL LATCH NAND R/S QUAD	SN74LS279N	
U15	0084960	IC TTL COUNTER BIN 35-MHZ	SN74LS161AN	01295
U16	0084960	IC TTL COUNTER BIN 35-MHZ	SN74LS161AN	01295
U17	0086646	IC TTL DECODER 2-BIT TO 1 OF 4 DUAL	SN74LS139N	
U18	0170306	IC TTL MULTIPLEXER 4-BIT/1-CHNL TO 1DUAL	SN74LS153N	
U19	0170321	IC TTL BUFFER QUAD 3-STATE	SN74LS126AN	
U20	0087981	IC TTL BUFFER QUAD 3-STATE	SN74LS125N	
U21	0084277	IC TTL GATE EX-OR 2-IN QUAD	SN74LS86N	01295
U22	0084283	IC TTL FLIP-FLOP TYPE-D DUAL	SN74LS74AN	01295
U23	0084830	IC TTL FLIP-FLOP TYPE-D QUAD	SN74LS175N	01295
U24	0089423	IC TIL GATE NAND 8-IN	SN74LS30N	
U25	0087867	IC TTL MULTI MONO RETRIG DUAL	SN74LS123J	
U26	0084281	IC TTL GATE INVERTER HEX	SN74LS04N	01295

ANALYZER BIT ERROR DETECTOR ASSEMBLY - 304157 (continued)

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
U27	0084282	IC TTL GATE AND 2-IN QUAD	SN74LS08N	01295
U28	0084283	IC TTL FLIP-FLOP TYPE-D DUAL	SN74LS74AN	01295
U29	0084282	IC TTL GATE AND 2-IN QUAD	SN74LS08N	01295
U30	0087233	RESISTOR NETWORK 7 1K OHM 2% 8 51P	4308R-101-102	
U31	0170306	IC TTL MULTIPLEXER 4-BIT/1-CHNL TO 1DUAL	SN74LS153N	
U32	0084284	IC TTL GATE NOR 3-IN TRIPLE	SN74LS27N	01295

ANALYZER DS1 FRAMING ASSEMBLY - 304151
REF DESIGNATION PREFIX: 4654A-A7

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
C1	0070671	CAPACITR 100 MF 25V	500D107G025DD7	80183
C2	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C3	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C4	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C5	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C6	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C7	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C8	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C9	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C10	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C11	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C12	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C13	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C14	0070475	CAPACITR 12 PF 1 KV CER DISC S2L 10%	DD-120	71590
C15	0070540	CAPACITR 470 PF 1KV CER DISC Z5F 10%	DD-471	71590
J1	0087366	CONN HEADER SGL ROW STRAIGHT 3-PIN PC	87220-3	
P2	0086884	JUMPER FEMALE INSULATED .10 SPACING	65474-004	
R1	0076274	RESISTOR 18 OHM 1/4W 10% COMP	RCR07G180KS	01121
R2	0076274	RESISTOR 18 OHM 1/4W 10% COMP	RCR07G180KS	01121
R3	0071951	RESISTOR 1.0K OHM 1/4W 10% COMP	RCR07G102KS	01121
R4	0072113	RESISTOR 100K OHM 1/4W 10% COMP	RCR07G104KS	01121
R5	0079720	RESISTOR 22.1K OHM RN55C 1% MTL FLM	RN55C2212F	
U1	0173651	IC RCVR SERIAL T1 IN TO PARALLEL OUT	R8060	
U2	0171880	IC TTL GATE INVERTER HEX	F74F04PC	
U3	0173604	IC TTL COUNTER BIN 100-MHZ	74F161PC	
U4	0173604	IC TTL COUNTER BIN 100-MHZ	74F161PC	
U5	0084280	IC TTL GATE NOR 2-IN QUAD	SN74LS02N	01295
U6	0084279	IC TTL GATE NAND 2-IN QUAD	SN74LS00N	01295
U7	0087867	IC TTL MULTI MONO RETRIG DUAL	SN74LS123J	
U8	0084281	IC TTL GATE INVERTER HEX	SN74LS04N	01295
U9	0084279	IC TTL GATE NAND 2-IN QUAD	SN74LS00N	01295
U10	0087694	IC TTL BUFFER NAND 4-IN DUAL	SN74S140J	
U11	0084283	IC TTL FLIP-FLOP TYPE-D DUAL	SN74LS74AN	01295
XU1	0086652	SOCKET 28 PIN DIP PC MT	ICT-286-S-TG30	

ANALYZER FRAME SYNC ASSEMBLY - 252825
REF DESIGNATION PREFIX: 4654A-A8

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
C1	0079003	CAPACITR 100 MF 16V	500D107G016DC7	80183
C2	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C3	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C4	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C5	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C6	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C7	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C8	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C9	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	121-050-X7R-103K	72982
C10	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C11	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C12	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C13	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C14	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C15	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C16	0070518	CAPACITR 100 PF 1KV CER DISC S3N 10%	DD-101	71590
C17	0070518	CAPACITR 100 PF 1KV CER DISC S3N 10%	DD-101	71590
C18	0070518	CAPACITR 100 PF 1KV CER DISC S3N 10%	DD-101	71590
C19	0070518	CAPACITR 100 PF 1KV CER DISC S3N 10%	DD-101	71590
C20	0070541	CAPACITR 500 PF 1KV CER DISC Z5F 10%	DD 501	71590
R1	0071951	RESISTOR 1.0K OHM 1/4W 10% COMP	RCR07G102KS	01121
R2	0078600	NOT ASSIGNED	FOR ENG ONLY	
R3	0076274	RESISTOR 18 OHM 1/4W 10% COMP	RCR07G180KS	01121
TP1	0082909	TERMINAL PRESS MT DISCONNECT .058 PIN	60599-1	00779
U1	0089528	IC TTL FLIP-FLOP TYPE-JK* DUAL	SN74LS109AN	
U2	0084281	IC TTL GATE INVERTER HEX	SN74LS04N	01295
U3	0084277	IC TTL GATE EX-OR 2-IN QUAD	SN74LS86N	01295
U4	0084282	IC TTL GATE AND 2-IN QUAD	SN74LS08N	01295
U5	0084280	IC TTL GATE NOR 2-IN QUAD	SN74LS02N	01295
U6	0084279	IC TTL GATE NAND 2-IN QUAD	SN74LS00N	01295
U7	0084279	IC TTL GATE NAND 2-IN QUAD	SN74LS00N	01295
U8	0084960	IC TTL COUNTER BIN 35-MHZ	SN74LS161AN	01295
U9	0173604	IC TTL COUNTER BIN 100-MHZ	74F161PC	
U10	0173604	IC TTL COUNTER BIN 100-MHZ	74F161PC	
U11	0084878	IC TTL COUNTER BIN 18-MHZ DIVIDE 2X6	SN74LS92N	01295
U12	0170322	IC TTL FLIP-FLOP TYPE-JK DUAL	SN74LS107AN	
U13	0085943	IC TTL DECODER 3-BIT TO 1 OF 8	SN74LS138N	
U14	0084279	IC TTL GATE NAND 2-IN QUAD	SN74LS00N	01295
U15	0085946	IC TTL GATE NAND 3-IN TRIPLE	SN74LS10N	
U16	0085946	IC TTL GATE NAND 3-IN TRIPLE	SN74LS10N	
U17	0170307	IC TTL REGISTER SHIFT 4-BIT BIDIRECTNAL	SN74LS194N	
U18	0084830	IC TTL FLIP-FLOP TYPE-D QUAD	SN74LS175N	01295
U19	0017030	IC TTL REGISTER SHIFT 4-BIT BIDIRECTNAL	SN74LS194N	
U20	0084960	IC TTL COUNTER BIN 35-MHZ	SN74LS161AN	01295
U21	0086646	IC TTL DECODER 2-BIT TO 1 OF 4 DUAL	SN74LS139N	
U22	0084285	IC TTL GATE OR 2-IN QUAD	SN74LS32N	01295
U23	0089528	IC TTL FLIP-FLOP TYPE-JK* DUAL	SN74LS109AN	
U24	0170307	IC TTL REGISTER SHIFT 4-BIT BIDIRECTNAL	SN74LS194N	
U25	0084281	IC TTL GATE INVERTER HEX	SN74LS04N	01295
U26	0087694	IC TTL BUFFER NAND 4-IN DUAL	SN74S140J	

ANALYZER DECODER/DETECTOR ASSEMBLY - 252822
REF DESIGNATION PREFIX: 4654A-A9

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
C1	0079003	CAPACITR 100 MF 16V	500D107G016DC7	80183
C2	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C3	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C4	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C5	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C6	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C7	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C8	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C9	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C10	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C11	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C12	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
J1	0087366	CONN HEADER SGL ROW STRAIGHT 3-PIN PC	87220-3	
P2	0086884	JUMPER FEMALE INSULATED .10 SPACING	65474-004	
R1	0071951	RESISTOR 1.0K OHM 1/4W 10% COMP	RCR07G102KS	01121
R2	0071951	RESISTOR 1.0K OHM 1/4W 10% COMP	RCR07G102KS	01121
R3	0078600	NOT ASSIGNED	FOR ENG ONLY	
R4	0076274	RESISTOR 18 OHM 1/4W 10% COMP	RCR07G180KS	01121
R5	0078600	NOT ASSIGNED	FOR ENG ONLY	
R6	0076274	RESISTOR 18 OHM 1/4W 10% COMP	RCR07G180KS	01121
TP1	0082909	TERMINAL PRESS MT DISCONNECT .058 PIN	60599-1	00779
TP2	0082909	TERMINAL PRESS MT DISCONNECT .058 PIN	60599-1	00779
U1	0170322	IC TTL FLIP-FLOP TYPE-JK DUAL	SN74LS107AN	
U2	0084279	IC TTL GATE NAND 2-IN QUAD	SN74LS00N	01295
U3	0087689	IC TTL REGISTER SHIFT 8-BIT S-IN P-OUT	TI SN74LS164J	
U4	0087689	IC TTL REGISTER SHIFT 8-BIT S-IN P-OUT	TI SN74LS164J	
U5	0087689	IC TTL REGISTER SHIFT 8-BIT S-IN P-OUT	TI SN74LS164J	
U6	0084284	IC TTL GATE NOR 3-IN TRIPLE	SN74LS27N	01295
U7	0089423	IC TIL GATE NAND 8-IN	SN74LS30N	
U8	0089423	IC TIL GATE NAND 8-IN	SN74LS30N	
U9	0084960	IC TTL COUNTER BIN 35-MHZ	SN74LS161AN	01295
U10	0084960	IC TTL COUNTER BIN 35-MHZ	SN74LS161AN	01295
U11	0084279	IC TTL GATE NAND 2-IN QUAD	SN74LS00N	01295
U12	0084281	IC TTL GATE INVERTER HEX	SN74LS04N	01295
U13	0084281	IC TTL GATE INVERTER HEX	SN74LS04N	01295
U14	0089527	IC TTL COUNTER DECADE 35-MHZ 2X5 DUAL	SN74LS390N	
U15	0089527	IC TTL COUNTER DECADE 35-MHZ 2X5 DUAL	SN74LS390N	
U16	0084032	IC TTL COUNTER DECADE 18-MHZ 2X5	SN74LS90N	01295
U17	0089528	IC TTL FLIP-FLOP TYPE-JK* DUAL	SN74LS109AN	
U18	0089528	IC TTL FLIP-FLOP TYPE-JK* DUAL	SN74LS109AN	
U19	0084277	IC TTL GATE EX-OR 2-IN QUAD	SN74LS86N	01295
U20	0087694	IC TTL BUFFER NAND 4-IN DUAL	SN74S140J	
U21	0087694	IC TTL BUFFER NAND 4-IN DUAL	SN74S140J	
U22	0084279	IC TTL GATE NAND 2-IN QUAD	SN74LS00N	01295

ANALYZER CLOCK RECOVERY ASSEMBLY - 252819
REF DESIGNATION PREFIX: 4654A-A10

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
C1	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C2	0081826	CAPACITR 110 PF 100V SILVER MICA 2%	D151C111G03	53021
C3	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C4	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C5	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C6	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C7	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C8	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C9	0070504	CAPACITR 50 PF 1 KV CER DISC S3N 10%	DD-500	71590
C10	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C11	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C12	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C13	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C14	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C15	0081792	CAPACITR 30 PF 100V CER DISC U1G 5%	805-024-U1G0-300J	72982
C16	0081792	CAPACITR 30 PF 100V CER DISC U1G 5%	805-024-U1G0-300J	72982
C17	0070544	CAPACITR .001 MF 1KV CER DISC Z5F 10%	DD102	71590
C18	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C19	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C20	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C21	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C22	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C23	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C24	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C25	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C26	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C27	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C28	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C29	0070651	CAPACITR 25 MF 25V	500D256G025CB7	80183
C30	0070651	CAPACITR 25 MF 25V	500D256G025CB7	80183
C31	0035656	CAPACITR 100 MF 20V SOLID TANT POL 10%	T362D107K020AS	05397
C32	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C33	0070651	CAPACITR 25 MF 25V	500D256G025CB7	80183
C34	0070651	CAPACITR 25 MF 25V	500D256G025CB7	80183
C35	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C36	0086727	CAPACITOR 15.0 PF 100V CER MONO NPO 1%	8111-100-C0G0-150F	
C37	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C38	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C39	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C40	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C41	0075417	CAPACITR .01 MF 150V CER DISC Z5V-40+60%	DDM-103	71590
C42	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C43	0070518	CAPACITR 100 PF 1KV CER DISC S3N 10%	DD-101	71590
C44	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C45	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C46	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C47	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C48	0035654	CAPACITR 10 MF 25V SOLID TANT POL 10%	T362B106K025AS	05397
C49	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C50	0075417	CAPACITR .01 MF 150V CER DISC Z5V-40+60%	DDM-103	71590
CR1	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR2	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR3	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR4	0083618	DIODE 5082-2800 DET UHF SCHOTTKY	5082-2800	28480
CR5	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR6	0082901	LAMP LED GRN .190 DIA .180 LNG 2.3V 20MA	FLV340	31718
CR7	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR8	0083984	DIODE 1N5228B SI ZEN 3.9V 5% .5W	1N5228B	13715
CR9	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR10	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
K1	0085285	RELAY 12VDC TO-5 PKG	732-12	
L1	0078508	INDUCTOR 8.2 UH SUBMIN UNSHLD 10%	IR-2	91637
P2	0086884	JUMPER FEMALE INSULATED .10 SPACING	65474-004	
Q1	0084815	TRANSSTR 2N6427 NPN SIL DARLINGTON PAIR	2N6427	04713
Q2	0081544	TRANSSTR 2N4856 SIL FET N-CHNL JUNC	2N4856	01295

ANALYZER CLOCK RECOVERY ASSEMBLY - 252819 (continued)

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
Q3	0081544	TRANSSTR 2N4856 SIL FET N-CHNL JUNC	2N4856	01295
Q4	0081544	TRANSSTR 2N4856 SIL FET N-CHNL JUNC	2N4856	01295
Q5	0081544	TRANSSTR 2N4856 SIL FET N-CHNL JUNC	2N4856	01295
R1	0072064	RESISTOR 33K OHM 1/4W 10% COMP	RCR07G333KS	01121
R2	0083885	RESISTOR 1.10K OHM RN55C 1% MTL FLM	RN55C1101F	
R3	0083869	RESISTOR 274 OHM RN55C 1% MTL FLM	RN55C2740F	
R4	0083869	RESISTOR 274 OHM RN55C 1% MTL FLM	RN55C2740F	
R5	0085745	RESISTOR 68.1 OHM RN55C 1% MTL FLM	RN55C68R1F	
R6	0078915	RESISTOR 221 OHM RN55C 1% MTL FLM	RN55C2210F	
R7	0078915	RESISTOR 221 OHM RN55C 1% MTL FLM	RN55C2210F	
R8	0083086	RESISTOR 56.2 OHM RN55C 1% MTL FLM	RN55C56R2F	
R9	0083869	RESISTOR 274 OHM RN55C 1% MTL FLM	RN55C2740F	
R10	0071926	RESISTOR 470 OHM 1/4W 10% COMP	RCR07G471KS	01121
R11	0071862	RESISTOR 47 OHM 1/4W 10% COMP	RCR07G470KS	01121
R12	0071862	RESISTOR 47 OHM 1/4W 10% COMP	RCR07G470KS	01121
R13	0078600	NOT ASSIGNED	FOR ENG ONLY	
R14	0071913	RESISTOR 270 OHM 1/4W 10% COMP	RCR07G271KS	01121
R15	0077524	RESISTOR 75 OHM 1/4W 5% COMP	RCR07G750JS	01121
R16	0072054	RESISTOR 22K OHM 1/4W 10% COMP	RCR07G223KS	01121
R17	0072054	RESISTOR 22K OHM 1/4W 10% COMP	RCR07G223KS	01121
R18	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R19	0087839	POT 5K OHM 1/2 CER 3/8 SQ VERT ADJ 25T	3299W-1-502	
R20	0072113	RESISTOR 100K OHM 1/4W 10% COMP	RCR07G104KS	01121
R21	0071862	RESISTOR 47 OHM 1/4W 10% COMP	RCR07G470KS	01121
R22	0071862	RESISTOR 47 OHM 1/4W 10% COMP	RCR07G470KS	01121
R23	0071926	RESISTOR 470 OHM 1/4W 10% COMP	RCR07G471KS	01121
R24	0071926	RESISTOR 470 OHM 1/4W 10% COMP	RCR07G471KS	01121
R25	0083939	RESISTOR 56.2K OHM RN55C 1% MTL FLM	RN55C5622F	
R26	0078933	RESISTOR 10.0K OHM RN55C 1% MTL FLM	RN55C1002F	
R27	0083874	RESISTOR 464 OHM RN55C 1% MTL FLM	RN55C4640F	
R28	0078928	RESISTOR 100K OHM RN55C 1% MTL FLM	RN55C1003F	
R29	0072002	RESISTOR 4.7K OHM 1/4W 10% COMP	RCR07G472KS	01121
R30	0078928	RESISTOR 100K OHM RN55C 1% MTL FLM	RN55C1003F	
R31	0072189	RESISTOR 1.0 MEG 1/4W 10% COMP	RCR07G105KS	01121
R32	0078930	RESISTOR 2.21K OHM RN55C 1% MTL FLM	RN55C2211F	
R33	0083910	RESISTOR 5.11K OHM RN55C 1% MTL FLM	RN55C5111F	
R34	0084055	RESISTOR 681 OHM RN55C 1% MTL FLM	RN55C6810F	
R35	0087837	POT 1K OHM 1/2W CER 3/8 SQ VERT ADJ 25T	3299W-1-102	
R36	0079863	RESISTOR 1.21K OHM RN55C 1% MTL FLM	RN55C1211F	
R37	0078929	RESISTOR 1.00K OHM RN55C 1% MTL FLM	RN55C1001F	
R38	079863	RESISTOR 1.21K OHM RN55C 1% MTL FLM	RN55C1211F	
R39	0078928	RESISTOR 100K OHM RN55C 1% MTL FLM	RN55C1003F	
R40	0083874	RESISTOR 464 OHM RN55C 1% MTL FLM	RN55C4640F	
R41	0079114	RESISTOR 10.0 OHM RN55D 1% MTL FLM	RN55D10R0F	
R42	0078929	RESISTOR 1.00K OHM RN55C 1% MTL FLM	RN55C1001F	
R43	0079863	RESISTOR 1.21K OHM RN55C 1% MTL FLM	RN55C1211F	
R44	0078928	RESISTOR 100K OHM RN55C 1% MTL FLM	RN55C1003F	
R45	0072002	RESISTOR 4.7K OHM 1/4W 10% COMP	RCR07G472KS	01121
R46	0077524	RESISTOR 75 OHM 1/4W 5% COMP	RCR07G750JS	01121
R47	0071966	RESISTOR 1.5K OHM 1/4W 10% COMP	RCR07G152KS	01121
R48	0071862	RESISTOR 47 OHM 1/4W 10% COMP	RCR07G470KS	01121
R49	0077524	RESISTOR 75 OHM 1/4W 5% COMP	RCR07G750JS	01121
R50	0071977	RESISTOR 2.2K OHM 1/4W 10% COMP	RCR07G222KS	01121
R51	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R52	0072014	RESISTOR 6.8K OHM 1/4W 10% COMP	RCR07G682KS	01121
R53	0078933	RESISTOR 10.0K OHM RN55C 1% MTL FLM	RN55C1002F	
R54	0084166	RESISTOR 8.25K OHM RN55C 1% MTL FLM	RN55C8251F	
R55	0087839	POT 5K OHM 1/2 CER 3/8 SQ VERT ADJ 25T	3299W-1-502	
R56	0082186	RESISTOR 750K OHM RN60C 1% MTL FLM	RN60C7503F	
R57	0079866	RESISTOR 6.19K OHM RN55C 1% MTL FLM	RN55C6191F	
R58	0083891	RESISTOR 1.50K OHM RN55C 1% MTL FLM	RN55C1501F	
R59	0083877	RESISTOR 536 OHM RN55C 1% MTL FLM	RN55C5360F	
R60	0087837	POT 1K OHM 1/2W CER 3/8 SQ VERT ADJ 25T	3299W-1-102	
R61	0079011	RESISTOR 2.49K OHM RN55C 1% MTL FLM	RN55C2491F	
R62	0087842	POT 50K OHM 1/2W CER 3/8 SQ VERT ADJ 25T	3299W-1-503	
R63	0079720	RESISTOR 22.1K OHM RN55C 1% MTL FLM	RN55C2212F	
R64	0072189	RESISTOR 1.0 MEG 1/4W 10% COMP	RCR07G105KS	01121
R65	0083903	RESISTOR 3.32K OHM RN55C 1% MTL FLM	RN55C3321F	
R66	0083903	RESISTOR 3.32K OHM RN55C 1% MTL FLM	RN55C3321F	

ANALYZER CLOCK RECOVERY ASSEMBLY - 252819 (continued)

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
R67	0079720	RESISTOR 22.1K OHM RN55C 1% MTL FLM	RN55C2212F	
R68	0072138	RESISTOR 220K OHM 1/4W 10% COMP	RCR07G224KS	01121
R69	0072207	RESISTOR 2.2 MEG 1/4W 10% COMP	RCR07G225KS	01121
R70	0071862	RESISTOR 47 OHM 1/4W 10% COMP	RCR07G470KS	01121
R71	0080386	RESISTOR 274K OHM RN55C 1% MTL FLM	RN55C2743F	
R72	0081341	RESISTOR 22 MEG 1/4W 10% COMP	RCR07G226KS	01121
R73	0083038	RESISTOR 6.81K OHM RN55C 1% MTL FLM	RN55C6811F	
R74	0080380	RESISTOR 2.74K OHM RN55C 1% MTL FLM	RN55C2741F	
R75	0083038	RESISTOR 6.81K OHM RN55C 1% MTL FLM	RN55C6811F	
R76	0078933	RESISTOR 10.0K OHM RN55C 1% MTL FLM	RN55C1002F	
R77	0071862	RESISTOR 47 OHM 1/4W 10% COMP	RCR07G470KS	01121
R78	0072189	RESISTOR 1.0 MEG 1/4W 10% COMP	RCR07G105KS	01121
R79	0078930	RESISTOR 2.21K OHM RN55C 1% MTL FLM	RN55C2211F	
R80	0087842	POT 50K OHM 1/2W CER 3/8 SQ VERT ADJ 25T	3299W-1-503	
R81	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R82	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R83	0072138	RESISTOR 220K OHM 1/4W 10% COMP	RCR07G224KS	01121
R84	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R85	0072138	RESISTOR 220K OHM 1/4W 10% COMP	RCR07G224KS	01121
R86	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R87	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R88	0071993	RESISTOR 3.9K OHM 1/4W 10% COMP	RCR07G392KS	01121
R89	0083097	RESISTOR 332 OHM RN55C 1% MTL FLM	RN55C3320F	
R90	0083097	RESISTOR 332 OHM RN55C 1% MTL FLM	RN55C3320F	
R91	0071966	RESISTOR 1.5K OHM 1/4W 10% COMP	RCR07G152KS	01121
R92	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R93	0072165	RESISTOR 470K OHM 1/4W 10% COMP	RCR07G474KS	01121
R94	0072138	RESISTOR 220K OHM 1/4W 10% COMP	RCR07G224KS	01121
R95	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R96	0071907	RESISTOR 220 OHM 1/4W 10% COMP	RCR07G221KS	01121
R97	0071989	RESISTOR 3.3K OHM 1/4W 10% COMP	RCR07G332KS	01121
R98	0071977	RESISTOR 2.2K OHM 1/4W 10% COMP	RCR07G222KS	01121
R99	0083087	RESISTOR 61.9 OHM RN55C 1% MTL FLM	RN55C61R9F	
RT1	0083617	THERMSTR 100 OHM DISC 25 DEG C 10%	FD21J1	15801
T1	0084082	XFMR MATCHING .15-400 MHZ 50 IN 50 OUT	T1-1	
T2	0170318	XFMR MATCHING .01-100 MHZ 50 IN 250 OUT	TM02.5-6T	
TP1	0087229	CONN HEADER SGL ROW STRAIGHT 2-PIN PC	87220-2	
TP2	0087229	CONN HEADER SGL ROW STRAIGHT 2-PIN PC	87220-2	
TP3	0082909	TERMINAL PRESS MT DISCONNECT .058 PIN	60599-1	00779
TP4	0082909	TERMINAL PRESS MT DISCONNECT .058 PIN	60599-1	00779
TP5	0082909	TERMINAL PRESS MT DISCONNECT .058 PIN	60599-1	00779
TP6	0082909	TERMINAL PRESS MT DISCONNECT .058 PIN	60599-1	00779
TP7	0082909	TERMINAL PRESS MT DISCONNECT .058 PIN	60599-1	00779
TP8	0087366	CONN HEADER SGL ROW STRAIGHT 3-PIN PC	87220-3	
U1	0083239	IC AMPL RF/IF/VIDEO DIF IN/OUT 8L-T099	MC1590G	04713
U2	0083239	IC AMPL RF/IF/VIDEO DIF IN/OUT 8L-T099	MC1590G	04713
U3	0086514	IC OP AMP JFET 8L-DIP 70C COMP DUAL	TL082ACP	
U4	0083504	IC LINE RECEIVER DUAL	75107P	01295
U5	0083504	IC LINE RECEIVER DUAL	75107P	01295
U6	0084279	IC TTL GATE NAND 2-IN QUAD	SN74LS00N	01295
U7	0087981	IC TTL BUFFER QUAD 3-STATE	SN74LS125N	
U8	0084285	IC TTL GATE OR 2-IN QUAD	SN74LS32N	01295
U9	0084283	IC TTL FLIP-FLOP TYPE-D DUAL	SN74LS74AN	01295
U10	0084281	IC TTL GATE INVERTER HEX	SN74LS04N	01295
U11	0084509	IC TTL MULTIPLEXER 8-BIT/1-CHNL TO1 3STE	SN74LS251N	01295
U12	0087804	IC TTL COUNTER BIN 35-MHZ DUAL	SN74LS393J	
U13	0083240	IC COMPARATOR-VOLTAGE 14L-DIP QUAD	LM339N	12040
U14	0171533	IC OSCILLATOR VCO TTL 20 MHZ 14L-DIP	SN74LS628N	
U15	0082645	IC VLTG RGLTR POS 5V 0.25A TYP TO39	LM309H	04713
U16	0086514	IC OP AMP JFET 8L-DIP 70C COMP DUAL	TL082ACP	
U17	0084283	IC TTL FLIP-FLOP TYPE-D DUAL	SN74LS74AN	01295

ANALYZER MOTHERBOARD ASSEMBLY - 304154
REF DESIGNATION PREFIX: A11

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
J1	0089673	CONN HEADER SGL ROW STRAIGHT 12-PIN PC	1-85830-2	
J2	0085127	CONN HEADER DBL ROW STRAIGHT 26-PIN PC	1-87227-3	00779
J3	0171548	CONN HEADER DBL ROW SIGHT 50-PIN + LATCH	3433-2202	
J4	0087034	CONN HEADER DBL ROW STRAIGHT 10-PIN PC	87478-2	
J5	0170200	CONN HEADER SGL ROW STRAIGHT 12-PIN PC	1-87220-2	
J6	0085125	CONN HEADER DBL ROW STRAIGHT 4-PIN PC	87227-2	00779
J7	0171518	CONN COAX MALE RT ANGLE TO PC BD MIN	50107-1	
J8	0171518	CONN COAX MALE RT ANGLE TO PC BD MIN	50107-1	
XA1	0087039	CONN 43 PIN EDGE TYPE LOW PROFILE	1-530655-3	
XA5	0087039	CONN 43 PIN EDGE TYPE LOW PROFILE	1-530655-3	
XA6	0087039	CONN 43 PIN EDGE TYPE LOW PROFILE	1-530655-3	
XA7	0087039	CONN 43 PIN EDGE TYPE LOW PROFILE	1-530655-3	
XA8	0087039	CONN 43 PIN EDGE TYPE LOW PROFILE	1-530655-3	
XA9	0087039	CONN 43 PIN EDGE TYPE LOW PROFILE	1-530655-3	
XA10	0087039	CONN 43 PIN EDGE TYPE LOW PROFILE	1-530655-3	

ANALYZER POWER SUPPLY ASSEMBLY - 252725
(AC VERSION ONLY)
REF DESIGNATION PREFIX: A12

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
2	0081453	FUS HLDR CLIP FOR 3AG OR 3AB PC MT 2 PIN	798	79963
C1	0171532	CAPACITR 15000 MF 16V	159TTA016APX	
C2	0077014	CAPACITR 4.7 MF 35V SOLID TANT POL 10%	T330C475K035AS	05397
C3	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C4	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C5	0070651	CAPACITR 25 MF 25V	500D256G025CB7	80183
C6	0171531	CAPACITR 4700 MF 35V	478TTA035APX	
C7	0077014	CAPACITR 4.7 MF 35V SOLID TANT POL 10%	T330C475K035AS	05397
C8	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C9	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C10	0070651	CAPACITR 25 MF 25V	500D256G025CB7	80183
C11	0171531	CAPACITR 4700 MF 35V	478TTA035APX	
C12	0077014	CAPACITR 4.7 MF 35V SOLID TANT POL 10%	T330C475K035AS	05397
C13	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C14	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C15	0070651	CAPACITR 25 MF 25V	500D256G025CB7	80183
C16	0070651	CAPACITR 25 MF 25V	500D256G025CB7	80183
C17	0078600	NOT ASSIGNED	FOR ENG ONLY	
C18	0080149	CAPACITR 4.7 MF 20V SOLID TANT POL 20%	196D475X0020JE3	80183
CR1	0078600	NOT ASSIGNED	FOR ENG ONLY	
CR2	0089538	DIODE 1N6267A ZEN TRAN SUPPRESSOR 6.8 V	1N6267A	
CR3	0082901	LAMP LED GRN .190 DIA .180 LNG 2.3V 20MA	FLV340	31718
CR4	0085492	RECTIFIER ASSY 200V 6A	VH248	83003
CR5	0082901	LAMP LED GRN .190 DIA .180 LNG 2.3V 20MA	FLV340	31718
CR6	0082901	LAMP LED GRN .190 DIA .180 LNG 2.3V 20MA	FLV340	31718
CR7	0089538	DIODE 1N6267A ZEN TRAN SUPPRESSOR 6.8 V	1N6267A	
CR8	0082901	LAMP LED GRN .190 DIA .180 LNG 2.3V 20MA	FLV340	31718
CR9	0079488	DIODE 1N5302 CURRENT REGULATOR 1.5MA	1N5302	04713
CR10	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR11	0078274	DIODE 1N4002 SIL 100V 1A	1N4002	04713
CR12	0078274	DIODE 1N4002 SIL 100V 1A	1N4002	04713
CR13	0078274	DIODE 1N4002 SIL 100V 1A	1N4002	04713
CR14	0089539	DIODE 1N6275A ZEN TRAN SUPPRESSOR 15 V	1N6275A	
CR15	0089539	DIODE 1N6275A ZEN TRAN SUPPRESSOR 15 V	1N6275A	
CR16	0078274	DIODE 1N4002 SIL 100V 1A	1N4002	04713
CR17	0078274	DIODE 1N4002 SIL 100V 1A	1N4002	04713
F1	0071229	FUSE 4 AMP	3AG 312004.	75915
F2	0071223	FUSE 2 AMP	3AG 312002.	75915
F3	0071223	FUSE 2 AMP	3AG 312002.	75915
J1	0087353	CONN RECT PIN HEADER PC BD 16 CIRCUIT	350214-1	
J2	0087042	CONN RECT PIN HEADER PC BD 10 CIRCUIT	1-380991-0	
Q1	0088412	THYRISTOR SCR 50PRV 25A RMS	2N6504	
Q2	0088412	THYRISTOR SCR 50PRV 25A RMS	2N6504	
Q3	0088412	THYRISTOR SCR 50PRV 25A RMS	2N6504	
Q4	0077148	TRANSSTR 2N3251 PNP SIL	2N3251	04713
Q5	0078215	TRANSSTR 2N5089 NPN SIL	2N5089	04713
R1	0078600	NOT ASSIGNED	FOR ENG ONLY	
R2	0078600	NOT ASSIGNED	FOR ENG ONLY	
R3	0079743	RESISTOR 750 OHM RN55C 1% MTL FLM	RN55C7500F	
R4	0083903	RESISTOR 3.32K OHM RN55C 1% MTL FLM	RN55C3321F	
R5	0083901	RESISTOR 2.61K OHM RN55C 1% MTL FLM	RN55C2611F	
R6	0076275	RESISTOR 22 OHM 1/4W 10% COMP	RCR07G220KS	01121
R7	0071907	RESISTOR 220 OHM 1/4W 10% COMP	RCR07G221KS	01121
R8	0071913	RESISTOR 270 OHM 1/4W 10% COMP	RCR07G271KS	01121
R9	0171526	RESISTOR .3 OHM 5W 5% WW	RS-5	
R10	0171526	RESISTOR .3 OHM 5W 5% WW	RS-5	
R11	0078600	NOT ASSIGNED	FOR ENG ONLY	
R12	0087837	POT 1K OHM 1/2W CER 3/8 SQ VERT ADJ 25T	3299W-1-102	
R13	0083917	RESISTOR 11.5K OHM RN55C 1% MTL FLM	RN55C1152F	
R14	0083901	RESISTOR 2.61K OHM RN55C 1% MTL FLM	RN55C2611F	
R15	0071862	RESISTOR 47 OHM 1/4W 10% COMP	RCR07G470KS	01121
R16	0071907	RESISTOR 220 OHM 1/4W 10% COMP	RCR07G221KS	01121
R17	0071941	RESISTOR 820 OHM 1/4W 10% COMP	RCR07G821KS	01121
R18	0087837	POT 1K OHM 1/2W CER 3/8 SQ VERT ADJ 25T	3299W-1-102	

ANALYZER POWER SUPPLY ASSEMBLY - 252725 (continued)

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
R19	0078600	NOT ASSIGNED	FOR ENG ONLY	
R20	0083917	RESISTOR 11.5K OHM RN55C 1% MTL FLM	RN55C1152F	
R21	0083901	RESISTOR 2.61K OHM RN55C 1% MTL FLM	RN55C2611F	
R22	0071951	RESISTOR 1.0K OHM 1/4W 10% COMP	RCR07G102KS	01121
R23	0071941	RESISTOR 820 OHM 1/4W 10% COMP	RCR07G821KS	01121
R24	0086963	RESISTOR 10 OHM 3W WW 5%	VAL3	
R25	0083867	RESISTOR 249 OHM RN55C 1% MTL FLM	RN55C2490F	
R26	0079743	RESISTOR 750 OHM RN55C 1% MTL FLM	RN55C7500F	
R27	0071913	RESISTOR 270 OHM 1/4W 10% COMP	RCR07G271KS	01121
R28	0084059	RESISTOR 6.98K OHM RN55C 1% MTL FLM	RN55C6981F	
R29	0072002	RESISTOR 4.7K OHM 1/4W 10% COMP	RCR07G472KS	01121
R30	0071926	RESISTOR 470 OHM 1/4W 10% COMP	RCR07G471KS	01121
R31	0071977	RESISTOR 2.2K OHM 1/4W 10% COMP	RCR07G222KS	01121
R32	0083891	RESISTOR 1.50K OHM RN55C 1% MTL FLM	RN55C1501F	
R33	0083891	RESISTOR 1.50K OHM RN55C 1% MTL FLM	RN55C1501F	
TP1	0082909	TERMINAL PRESS MT DISCONNECT .058 PIN	60599-1	00779
TP2	0082909	TERMINAL PRESS MT DISCONNECT .058 PIN	60599-1	00779
TP3	0082909	TERMINAL PRESS MT DISCONNECT .058 PIN	60599-1	00779
TP4	0082909	TERMINAL PRESS MT DISCONNECT .058 PIN	60599-1	00779
TP5	0082909	TERMINAL PRESS MT DISCONNECT .058 PIN	60599-1	00779
TP6	0082909	TERMINAL PRESS MT DISCONNECT .058 PIN	60599-1	00779
U1	0086086	IC OVERVOLTAGE CROWBAR SENSING CIRCUIT	MC3423U	
U2	0086086	IC OVERVOLTAGE CROWBAR SENSING CIRCUIT	MC3423U	
U3	0086086	IC OVERVOLTAGE CROWBAR SENSING CIRCUIT	MC3423U	
U4	0088334	IC VLTG RGLTR -1.2 TO -37V .8A TYP TO220	LM337T	

ANALYZER -5.2V/-12V POWER SUPPLY ASSEMBLY - 220905
(AC/DC VERSION ONLY)
REF DESIGNATION PREFIX: 4654A-A12

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
2	0079335	PAD TRANSSTR TO5 & TO18 TO TO5	13103	7717-44-DAP
3	0077828	INSULATR THERMA-FILM FOR TO-3 TRANSISTOR	43-03-4	13103
C1	0081099	CAPACITR .0047 MF 100V CER MONO X7R 10%	8121-100-X7R-472K	72982
C2	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C3	0080148	CAPACITR 10 MF 20V SOLID TANT POL 20%	T362B106M020AS	80183
C4	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C5	0086013	CAPACITR 22 MF 25V SOLID TANT POL 10%	T362C226K025AS	
C6	0080148	CAPACITR 10 MF 20V SOLID TANT POL 20%	T362B106M020AS	80183
C7	0084225	CAPACITR .22 MF 100V CER MONO 20%	8131-100-651-224M	72982
C8	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C9	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C10	0081118	CAPACITR .00598 MF 100V SILVER MICA 5%	D191CXXXJ03 5980 PF	53021
C11	0070518	CAPACITR 100PF IRV CER DISC S3N 10%	CO-101	71590
C12	0089645	CAPACITR 220 MF 60V	673D227H0XJE5C	
C13	0170264	CAPACITR 1 MF 100V CER MONO 651 20%	8141-100-651-105M	
C14	0170264	CAPACITR 1 MF 100V CER MONO 651 20%	8141-100-651-105M	
C15	0089643	CAPACITR 1000 MF 15V	672D108H015ET5C	
C16	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C17	0089644	CAPACITR 1000 MF 20V	673D108H020JE5C	
C18	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C19	0080148	CAPACITR 10 MF 20V SOLID TANT POL 20%	T362B106M020AS	80183
C20	0170263	CAPACITR 100 MF 20V	672D107H020CG5C	
C21	0080148	CAPACITR 10 MF 20V SOLID TANT POL 20%	T362B106M020AS	80183
C22	0081099	CAPACITR .0047 MF 100V CER MONO X7R 10%	8121-100-X7R-472K	72982
C23	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C24	0081118	CAPACITR .00598 MF 100V SILVER MICA 5%	D191CXXXJ03 5980 PF	53021
C25	0070518	CAPACITR 100 PF 1KV CER DISC S3N 10%	DD-101	71590
C26	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C27	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C28	0170263	CAPACITR 100 MF 20V	672D107H020CG5C	
C29	0080149	CAPACITR 4.7 MF 20V SOLID TANT POL 20%	196D475X0020JE3	80183
C30	0080149	CAPACITR 4.7 MF 20V SOLID TANT POL 20%	196D475X0020JE3	80183
C31	0089643	CAPACITR 1000 MF 15V	672D108H015ET5C	
C32	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C33	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C34	0080148	CAPACITR 10 MF 20V SOLID TANT POL 20%	T362B106M020AS	80183
C35	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
CR1	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR2	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR3	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR4	0071121	DIODE 1N821 TC REF 6.2V .01% .4W	1N821	04713
CR5	0078274	DIODE 1N4002 SIL 100V 1A	1N4002	04713
CR6	0083986	DIODE 1N4746A SI ZEN 18V 5% 1W	1N4746A	04713
CR7	0071122	DIODE 1N914 SIL 75V 75MA	IN914	80368
CR8	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR9	0071142	DIODE 1N4154 SIL 25V 150MA	1N4154	80368
CR10	0078274	DIODE 1N4002 SIL 100V 1A	1N4002	04713
CR11	0078274	DIODE 1N4002 SIL 100V 1A	1N4002	04713
CR12	0089684	DIODE MR821 SIL 100V 5A FAST REC	MR821	
CR13	0171572	THYRISTOR SCR 200PRV 25A RMS	C129B5	
CR14	0071121	DIODE 1N821 TC REF 6.2V .01% .4W	1N821	04713
CR15	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR16	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR17	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR18	0071142	DIODE 1N4154 SIL 25V 150MA	1N4154	80368
CR19	0078274	DIODE 1N4002 SIL 100V 1A	1N4002	04713
CR20	0089679	DIODE 80SQ030 SIL 30V 8A SCHOTTKY	80SQ030	
CR21	0082901	LAMP LED GRN .190 DIA .180 LNG 2.3V 20MA	FLV340	31718
CR22	0082901	LAMP LED GRN .190 DIA .180 LNG 2.3V 20MA	FLV340	31718
CR23	0078714	DIODE 1N4744A SI ZEN 15V 5% 1W	1N4744A	04713
CR24	0071143	DIODE 1N4735A SI ZEN 6.2V 5% 1W	1N4735A	04713
CR25	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR26	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
J1	0087042	CONN RECT PIN HEADER PC BD 10 CIRCUIT	1-380991-0	
J2	0087357	CONN RECT PIN HEADER PC BD 2 CKT BLUE	6-350539-2	

ANALYZER -5.2V/-12V POWER SUPPLY ASSEMBLY - 220905 (continued)

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
L1	0078841	INDUCTOR 4.7 MH MIN SHLD ENCAP 10%	WEE-4700	72259
L2	0089688	INDUCTOR 1.5 UH FERRITE 16.2 A PC MT	3443-04	
L3	0220937	COIL ASSY 650 UHY SER 4650		
L4	0089683	INDUCTOR 50 UH UNSHLD 10%	6310-6	
L5	0089688	INDUCTOR 1.5 UH FERRITE 16.2 A PC MT	3443-04	
L6	0078841	INDUCTOR 4.7 MH MIN SHLD ENCAP 10%	WEE-4700	72259
Q1	0076316	TRANSSTR 2N4036 PNP SIL	2N4036S	79089
Q2	0084113	TRANSSTR TIP 111 NPN SIL DARLINGTON PAIR	TIP 111	01295
Q3	0077147	TRANSSTR 2N3947 NPN SIL	2N3947	04713
Q4	0080007	TRANSSTR 2N2102 NPN SIL	2N2102	79089
Q5	0077148	TRANSSTR 2N3251 PNP SIL	2N3251	04713
Q6	0089669	TRANSSTR IRF132 FET N-CHNL MOS POWER	IRF132	
Q7	0081633	TRANSTR MPS-L51 PNP SIL	MPS-L51	04713
Q8	0077148	TRANSSTR 2N3251 PNP SIL	2N3251	04713
Q9	0089669	TRANSSTR IRF132 FET N-CHNL MOS POWER	IRF132	
Q10	0080824	TRANSSTR 2N5415 PNP SIL	2N5415	04713
Q11	0080824	TRANSSTR 2N5415 PNP SIL	2N5415	04713
Q12	0078214	TRANSSTR 2N5087 PNP SIL	2N5087	04713
R1	0072040	RESISTOR 15K OHM 1/2W 10% COMP	RCR20G153KS	01121
R2	0071879	RESISTOR 82 OHM 1/4W 10% COMP	RCR07G820KS	01121
R3	0071951	RESISTOR 1.0K OHM 1/4W 10% COMP	RCR07G102KS	01121
R4	0071833	RESISTOR 6.8 OHM 1/2W 10% COMP	RCR20G6R8KS	01121
R5	0078929	RESISTOR 1.00K OHM RN55C 1% MTL FLM	RN55C1001F	
R6	0083889	RESISTOR 1.40K OHM RN55C 1% MTL FLM	RN55C1401F	
R7	0085551	POT 5K OHM 1/2W CER 3/8 SQ HOR ADJ 20T	66XR5K	73138
R8	0072068	RESISTOR 39K OHM 1/4W 10% COMP	RCR07G393KS	01121
R9	0071982	RESISTOR 2.7K OHM 1/4W 10% COMP	RCR07G272KS	01121
R10	0072002	RESISTOR 4.7K OHM 1/4W 10% COMP	RCR07G472KS	01121
R11	0072002	RESISTOR 4.7K OHM 1/4W 10% COMP	RCR07G472KS	01121
R12	0071941	RESISTOR 820 OHM 1/4W 10% COMP	RCR07G821KS	01121
R13	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R14	0083907	RESISTOR 4.22K OHM RN55C 1% MTL FLM	RN55C4221F	
R15	0071989	RESISTOR 3.3K OHM 1/4W 10% COMP	RCR07G332KS	01121
R16	0074714	RESISTOR 3.3K OHM 1/4W 5% COMP	RCR07G332JS	01121
R17	0074675	RESISTOR 100 OHM 1/4W 5% COMP	RCR07G101JS	01121
R18	0087584	RESISTOR .10 OHM 3W 1%	RS-2C .10 OHM 1%	
R19	0076396	RESISTOR 1.0 OHM 1/2W 10% COMP	RCR20G1R0KS	01121
R20	0071827	RESISTOR 4.7 OHM 1W 10% COMP	RCR32G4R7KS	01121
R21	0071951	RESISTOR 1.0K OHM 1/4W 10% COMP	RCR07G102KS	01121
R22	0078931	RESISTOR 4.99K OHM RN55C 1% MTL FLM	RN55C4991F	
R23	0088389	POT 2K OHM 1/2W CER 3/8 SQ HOR ADJ 25T	3299X-1-202	
R24	0076981	RESISTOR 5.90K OHM RN55C 1% MTL FLM	RN55C5901F	
R25	0079085	RESISTOR 100 OHM 3W WW 5%	VAL-3	24681
R26	0079128	RESISTOR 768 OHM RN55C 1% MTL FLM	RN55C7680F	
R27	0071873	RESISTOR 56 OHM 1/4W 10% COMP	RCR07G560KS	01121
R28	0072039	RESISTOR 15K OHM 1/4W 10% COMP	RCR07G153KS	01121
R29	0071973	RESISTOR 1.8K OHM 1/4W 10% COMP	RCR07G182KS	01121
R30	0085551	POT 5K OHM 1/2W CER 3/8 SQ HOR ADJ 20T	66XR5K	73138
R31	0072068	RESISTOR 39K OHM 1/4W 10% COMP	RCR07G393KS	01121
R32	0072002	RESISTOR 4.7K OHM 1/4W 10% COMP	RCR07G472KS	01121
R33	0072002	RESISTOR 4.7K OHM 1/4W 10% COMP	RCR07G472KS	01121
R34	0071973	RESISTOR 1.8K OHM 1/4W 10% COMP	RCR07G182KS	01121
R35	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R36	0083901	RESISTOR 2.61K OHM RN55C 1% MTL FLM	RN55C2611F	
R37	0071989	RESISTOR 3.3K OHM 1/4W 10% COMP	RCR07G332KS	01121
R38	0074714	RESISTOR 3.3K OHM 1/4W 5% COMP	RCR07G332JS	01121
R39	0074675	RESISTOR 100 OHM 1/4W 5% COMP	RCR07G101JS	01121
R40	0087584	RESISTOR .10 OHM 3W 1%	RS-2C .10 OHM 1%	
R41	0071939	RESISTOR 680 OHM 1/2W 10% COMP	RCR20G681KS	01121
R42	0071862	RESISTOR 47 OHM 1/4W 10% COMP	RCR07G470KS	01121
R43	0071907	RESISTOR 220 OHM 1/4W 10% COMP	RCR07G221KS	01121
R44	0071939	RESISTOR 680 OHM 1/2W 10% COMP	RCR20G681KS	01121
R45	0071901	RESISTOR 180 OHM 1/4W 10% COMP	RCR07G181KS	01121
R46	0076275	RESISTOR 22 OHM 1/4W 10% COMP	RCR07G220KS	01121
R47	0071907	RESISTOR 220 OHM 1/4W 10% COMP	RCR07G221KS	01121
R48	0071951	RESISTOR 1.0K OHM 1/4W 10% COMP	RCR07G102KS	01121
R49	0071989	RESISTOR 3.3K OHM 1/4W 10% COMP	RCR07G332KS	01121
R50	0071867	RESISTOR 50 OHM 3W WW 5%	VAL3	24681

ANALYZER -5.2V/-12V POWER SUPPLY ASSEMBLY - 220905 (continued)

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
R51	0083038	RESISTOR 6.81K OHM RN55C 1% MTL FLM	RN55C6811F	
R52	0079104	RESISTOR 5.36K OHM RN55C 1% MTL FLM	RN55C5361F	
R53	0072039	RESISTOR 15K OHM 1/4W 10% COMP	RCR07G153KS	01121
R54	0071857	RESISTOR 33 OHM 1/4W 10% COMP	RCR07G330KS	01121
R55	0072019	RESISTOR 8.2K OHM 1/4W 10% COMP	RCR07G822KS	01121
R56	0071977	RESISTOR 2.2K OHM 1/4W 10% COMP	RCR07G222KS	01121
TP1	0082909	TERMINAL PRESS MT DISCONNECT .058 PIN	60599-1	00779
TP2	0082909	TERMINAL PRESS MT DISCONNECT .058 PIN	60599-1	00779
TP3	0082909	TERMINAL PRESS MT DISCONNECT .058 PIN	60599-1	00779
TP4	0082909	TERMINAL PRESS MT DISCONNECT .058 PIN	60599-1	00779
TP5	0082909	TERMINAL PRESS MT DISCONNECT .058 PIN	60599-1	00779
U1	0085993	IC VLTG RGLTR/PW MOD 70C 16L-DIP	SG3524	
U2	0084890	IC OP AMP 8L-DIP 70C COMP 741C	MC1741CP1	04713
U3	0085993	IC VLTG RGLTR/PW MOD 70C 16L-DIP	SG3524	
U4	0084890	IC OP AMP 8L-DIP 70C COMP 741C	MC1741CP1	04713

ANALYZER +5V/+12V POWER SUPPLY ASSEMBLY - 220917
(AC/DC VERSION ONLY)
REF DESIGNATION PREFIX: 4654A-A13

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
3	0077828	INSULATR THERMA-FILM FOR TO-3 TRANSISTOR	43-03-4	13103
11	0079335	PAD TRANSSTR TO5 & TO18 TO TO5	7717-44-DAP	13103
C1	0080148	CAPACITR 10 MF 20V SOLID TANT POL 20%	T362B106M020AS	80183
C2	0084225	CAPACITR .22 MF 100V CER MONO 20%	8131-100-651-224M	72982
C3	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C4	0070552	CAPACITR .002 MF 1KV CER DISC Z5U 20%	DD202	71590
C5	0081118	CAPACITR .00598 MF 100V SILVER MICA 5%	D191CXXXJ03 5980 PF	53021
C6	0070518	CAPACITR 100 PF 1KV CER DISC S3N 10%	DD-101	71590
C7	0089645	CAPACITR 220 MF 60V	673D227H0XJE5C	
C8	0070552	CAPACITR .002 MF 1KV CER DISC Z5U 20%	DD202	71590
C9	0080148	CAPACITR 10 MF 20V SOLID TANT POL 20%	T362B106M020AS	80183
C10	0073498	CAPACITR 820 PF 500V SILVER MICA 5%	CD19FD821J03	14655
C11	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C12	0081118	CAPACITR .00598 MF 100V SILVER MICA 5%	D191CXXXJ03 5980 PF	53021
C13	0070518	CAPACITR 100 PF 1KV CER DISC S3N 10%	DD-101	71590
C14	0081098	CAPACITR .47 MF 50V CER MONO 20%	8131-050-651-474M	72982
C15	0089643	CAPACITR 1000 MF 15V	672D108H015ET5C	
C16	0080149	CAPACITR 4.7 MF 20V SOLID TANT POL 20%	196D475X0020JE3	80183
C17	0170264	CAPACITR 1 MF 100V CER MONO 651 20%	8141-100-651-105M	
C18	0086013	CAPACITR 22 MF 25V SOLID TANT POL 10%	T362C226K025AS	
C19	0086013	CAPACITR 22 MF 25V SOLID TANT POL 10%	T362C226K025AS	
C20	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C21	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C22	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C23	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C24	0070552	CAPACITR .002 MF 1KV CER DISC Z5U 20%	DD202	71590
C25	0170263	CAPACITR 100 MF 20V	672D107H020CG5C	
C26	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C27	0070561	CAPACITR .005 MF 1KV CER DISC Z5U 20%	DD5022	71590
C28	0089644	CAPACITR 1000 MF 20V	673D108H020JE5C	
C29	0170263	CAPACITR 100 MF 20V	672D107H020CG5C	
C30	0081995	CAPACITR .001 MF 100V CER MONO X7R 10%	8121-100-X7R-102K	72982
C31	0080149	CAPACITR 4.7 MF 20V SOLID TANT POL 20%	196D475X0020JE3	80183
C32	0170264	CAPACITR 1 MF 100V CER MONO 651 20%	8141-100-651-105M	
CR1	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR2	0071122D	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR3	0071142	DIODE 1N4154 SIL 25V 150MA	1N4154	80368
CR4	0071142	DIODE 1N4154 SIL 25V 150MA	1N4154	80368
CR5	0083986	DIODE 1N4746A SI ZEN 18V 5% 1W	1N4746A	04713
CR6	0078274	DIODE 1N4002 SIL 100V 1A	1N4002	04713
CR7	0171572	THYRISTOR SCR 200PRV 25A RMS	C129B5	
CR8	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR9	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR10	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR11	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR12	0078274	DIODE 1N4002 SIL 100V 1A	1N4002	04713
CR13	0089679	DIODE 80SQ030 SIL 30V 8A SCHOTTKY	80SQ030	
CR14	0071143	DIODE 1N4735A SI ZEN 6.2V 5% 1W	1N4735A	04713
CR15	0071111	DIODE 1N459A SIL 175V 40MA	1N459A	80368
CR16	0082901	LAMP LED GRN .190 DIA .180 LNG 2.3V 20MA	FLV340	31718
CR17	0079488	DIODE 1N5302 CURRENT REGULATOR 1.5MA	IN5302	04713
CR18	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR19	0078274	DIODE 1N4002 SIL 100V 1A	1N4002	04713
CR20	0078274	DIODE 1N4002 SIL 100V 1A	1N4002	04713
CR21	0078274	DIODE 1N4002 SIL 100V 1A	1N4002	04713
CR22	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR23	0089681	RECTIFIER ASSY 200V 10A FAST REC.200 NSC	VI248X	
CR24	0078714	DIODE 1N4744A SI ZEN 15V 5% 1W	1N4744A	04713
CR25	0071111	DIODE 1N459A SIL 175V 40MA	1N459A	80368
CR26	0082901	LAMP LED GRN .190 DIA .180 LNG 2.3V 20MA	FLV340	31718
CR27	0078274	DIODE 1N4002 SIL 100V 1A	1N4002	04713
J1	0087042	CONN RECT PIN HEADER PC BD 10 CIRCUIT	1-380991-0	
L1	0078841	INDUCTOR 4.7 MH MIN SHLD ENCAP 10%	WEE-4700	72259
L2	022936	A COIL ASSY 420 UHY SER 4650		
L3	0089688	INDUCTOR 1.5 UH FERRITE 16.2 A PC MT	3443-04	
L4	0220936	A COIL ASSY 420 UHY SER 4650		

ANALYZER +5V/+12V POWER SUPPLY ASSEMBLY - 220917 (continued)

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
L5	0089683	INDUCTOR 50 UH UNSHLD 10%	6310-6	
Q1	0077148	TRANSSTR 2N3251 PNP SIL	2N3251	04713
Q2	0089670	TRANSSTR IRF230 FET N-CHNL MOS POWER	IRF230	
Q3	0089670	TRANSSTR IRF230 FET N-CHNL MOS POWER	IRF230	
Q4	0077148	TRANSSTR 2N3251 PNP SIL	2N3251	04713
Q5	0077148	TRANSSTR 2N3251 PNP SIL	2N3251	04713
Q6	0089669	TRANSSTR IRF132 FET N-CHNL MOS POWER	IRF132	
Q7	0080824	TRANSSTR 2N5415 PNP SIL	2N5415	04713
Q8	0081633	TRANSTR MPS-L51 PNP SIL	MPS-L51	04713
Q9	0081633	TRANSTR MPS-L51 PNP SIL	MPS-L51	04713
Q10	0078215	TRANSSTR 2N5089 NPN SIL	2N5089	04713
Q11	0080824	TRANSSTR 2N5415 PNP SIL	2N5415	04713
R1	0085551	POT 5K OHM 1/2W CER 3/8 SQ HOR ADJ 20T	66XR5K	73138
R2	0072068	RESISTOR 39K OHM 1/4W 10% COMP	RCR07G393KS	01121
R3	0083902	RESISTOR 3.01K OHM RN55C 1% MTL FLM	RN55C3011F	
R4	0087193	POT 1K OHM 1/2W CER 3/8 SQ HDR ADJ 20T	MT4Y102	
R5	0083898	RESISTOR 2.15K OHM RN55C 1% MTL FLM	RN55C2151F	
R6	0071993	RESISTOR 3.9K OHM 1/4W 10% COMP	RCR07G392KS	01121
R7	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R8	0083881	RESISTOR 866 OHM RN55C 1% MTL FLM	RN55C8660F	
R9	0083907	RESISTOR 4.22K OHM RN55C 1% MTL FLM	RN55C4221F	
R10	0074714	RESISTOR 3.3K OHM 1/4W 5% COMP	RCR07G332JS	01121
R11	0078110	RESISTOR 180 OHM 1/4W 5% COMP	RCR07G181JS	01121
R12	0078600	NOT ASSIGNED	FOR ENG ONLY	
R13	0071989	RESISTOR 3.3K OHM 1/4W 10% COMP	RCR07G332KS	01121
R14	0071867	RESISTOR 50 OHM 3W WW 5%	VAL3	24681
R15	0087584	RESISTOR .10 OHM 3W 1%	RS-2C .10 OHM 1%	
R16	0071989	RESISTOR 3.3K OHM 1/4W 10% COMP	RCR07G332KS	01121
R17	0085551	POT 5K OHM 1/2W CER 3/8 SQ HOR ADJ 20T	66XR5K	73138
R18	0072068	RESISTOR 39K OHM 1/4W 10% COMP	RCR07G393KS	01121
R19	0083902	RESISTOR 3.01K OHM RN55C 1% MTL FLM	RN55C3011F	
R20	0087193	POT 1K OHM 1/2W CER 3/8 SQ HDR ADJ 20T	MT4Y102	
R21	0083898	RESISTOR 2.15K OHM RN55C 1% MTL FLM	RN55C2151F	
R22	0071951	RESISTOR 1.0K OHM 1/4W 10% COMP	RCR07G102KS	01121
R23	0083901	RESISTOR 2.61K OHM RN55C 1% MTL FLM	RN55C2611F	
R24	0072002	RESISTOR 4.7K OHM 1/4W 10% COMP	RCR07G472KS	01121
R25	0071966	RESISTOR 1.5K OHM 1/4W 10% COMP	RCR07G152KS	01121
R26	0071867	RESISTOR 50 OHM 3W WW 5%	VAL3	24681
R27	0076275	RESISTOR 22 OHM 1/4W 10% COMP	RCR07G220KS	01121
R28	0071907	RESISTOR 220 OHM 1/4W 10% COMP	RCR07G221KS	01121
R29	0071939	RESISTOR 680 OHM 1/2W 10% COMP	RCR20G681KS	01121
R30	0071901	RESISTOR 180 OHM 1/4W 10% COMP	RCR07G181KS	01121
R31	0072002	RESISTOR 4.7K OHM 1/4W 10% COMP	RCR07G472KS	01121
R32	0071853	RESISTOR 27 OHM 1/4W 10% COMP	RCR07G270KS	01121
R33	0071853	RESISTOR 27 OHM 1/4W 10% COMP	RCR07G270KS	01121
R34	0072002	RESISTOR 4.7K OHM 1/4W 10% COMP	RCR07G472KS	01121
R35	0071918	RESISTOR 330 OHM 1/4W 10% COMP	RCR07G331KS	01121
R36	0072064	RESISTOR 33K OHM 1/4W 10% COMP	RCR07G333KS	01121
R37	0082128	RESISTOR 12.1K OHM RN60C 1% MTL FLM	RN60C1212F	
R38	0071853	RESISTOR 27 OHM 1/4W 10% COMP	RCR07G270KS	01121
R39	0083902	RESISTOR 3.01K OHM RN55C 1% MTL FLM	RN55C3011F	
R40	0079713	RESISTOR 2.00K OHM RN55C 1% MTL FLM	RN55C2001F	
R41	0083902	RESISTOR 3.01K OHM RN55C 1% MTL FLM	RN55C3011F	
R42	0071831	RESISTOR 5.6 OHM 1/2W 10% COMP	RCR20G5R6KS	01121
R43	0079085	RESISTOR 100 OHM 3W WW 5%	VAL-3	2481
R44	0071862	RESISTOR 47 OHM 1/4W 10% COMP	RCR07G470KS	01121
R45	0071907	RESISTOR 220 OHM 1/4W 10% COMP	RCR07G221KS	01121
R46	0071939	RESISTOR 680 OHM 1/2W 10% COMP	RCR20G681KS	01121
T1	0220933	TRANSFORMR PWR SWITCHING SER 4650	SX-1518	
TP1	0076490	JACK TEST BLUE	105-810	74970
TP2	0076490	JACK TEST BLUE	105-810	74970
TP3	0076490	JACK TEST BLUE	105-810	74970
TP4	0076490	JACK TEST BLUE	105-810	74970
U1	0085993	IC VLTG RGLTR/PW MOD 70C 16L-DIP	SG3524	
U2	0085993	IC VLTG RGLTR/PW MOD 70C 16L-DIP	SG3524	
U3	0086269	IC OP AMP PMOS 8L-TO5 70C COMP	CA3140T	
U4	0083806	IC TIMER 8L-DIP	NE555N	18324
W1	0314207	CABLE ASSY W1 POWER SUPPLY		

ANALYZER FRONT PANEL ASSEMBLY - 304142
REF DESIGNATION PREFIX: 4654A-A14

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
10	0089611	PUSHBUTTON BLACK FOR SA PN 89610	B305BL	
11	0170260	PUSHBUTTON BLUE FOR SA PN 89610	B305BU	
12	0089629	PUSHBUTTON RED FOR SA PN 89610	B305RD	
13	0256282	MASK, COLON-CLOCK DISPLAY		
A1	0304145	PWB ASSY FR PNL ANALYZER 4654A		
A2	0304169	PWB ASSY FR PNL DISPLAY 4654A		
A3	0304171	PWB ASSY FR PNL IND 4654A		
A4	0304167	PWB ASSY FR PNL I/O 4654A		
W1	0252806	CBL ASSY DS1/1C/2 INPUT 4654		
W2	0252809	CBL ASSY NRZ CLOCK INPUT 4654		
W3	0252815	CBL ASSY NRZ DATA INPUT 4654		
W4	0252783	CBL ASSY FR PNL I/O BERTS 4650		

ANALYZER FRONT PANEL PWB ASSEMBLY - 304145
REF DESIGNATION PREFIX: 4654A-A14A1

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
Q1	0083033	TRANSSTR 2N2907A PNP SIL	2N2907A	
Q2	0083033	TRANSSTR 2N2907A PNP SIL	2N2907A	
Q3	0083033	TRANSSTR 2N2907A PNP SIL	2N2907A	
Q4	0083033	TRANSSTR 2N2907A PNP SIL	2N2907A	
Q5	0083033	TRANSSTR 2N2907A PNP SIL	2N2907A	
Q6	0083033	TRANSSTR 2N2907A PNP SIL	2N2907A	
Q7	0083033	TRANSSTR 2N2907A PNP SIL	2N2907A	
Q8	0083033	TRANSSTR 2N2907A PNP SIL	2N2907A	
Q9	0084815	TRANSSTR 2N6427 NPN SIL DARLINGTON PAIR	2N6427	04713
Q10	0084815	TRANSSTR 2N6427 NPN SIL DARLINGTON PAIR	2N6427	04713
Q11	0084815	TRANSSTR 2N6427 NPN SIL DARLINGTON PAIR	2N6427	04713
Q12	0084815	TRANSSTR 2N6427 NPN SIL DARLINGTON PAIR	2N6427	04713
Q13	0084815	TRANSSTR 2N6427 NPN SIL DARLINGTON PAIR	2N6427	04713
Q14	0084815	TRANSSTR 2N6427 NPN SIL DARLINGTON PAIR	2N6427	04713
Q15	0084815	TRANSSTR 2N6427 NPN SIL DARLINGTON PAIR	2N6427	04713
Q16	0084815	TRANSSTR 2N6427 NPN SIL DARLINGTON PAIR	2N6427	04713
Q17	0084815	TRANSSTR 2N6427 NPN SIL DARLINGTON PAIR	2N6427	04713
Q18	0084815	TRANSSTR 2N6427 NPN SIL DARLINGTON PAIR	2N6427	04713
Q19	0084815	TRANSSTR 2N6427 NPN SIL DARLINGTON PAIR	2N6427	04713
Q20	0084815	TRANSSTR 2N6427 NPN SIL DARLINGTON PAIR	2N6427	04713
Q21	0084815	TRANSSTR 2N6427 NPN SIL DARLINGTON PAIR	2N6427	04713
Q22	0084815	TRANSSTR 2N6427 NPN SIL DARLINGTON PAIR	2N6427	04713
Q23	0084815	TRANSSTR 2N6427 NPN SIL DARLINGTON PAIR	2N6427	04713
Q24	0084815	TRANSSTR 2N6427 NPN SIL DARLINGTON PAIR	2N6427	04713
Q25	0084815	TRANSSTR 2N6427 NPN SIL DARLINGTON PAIR	2N6427	04713
R1	0076280	RESISTOR 6.8 OHM 1/4W 10% COMP	RCR07G6R8KS	01121
R2	0076280	RESISTOR 6.8 OHM 1/4W 10% COMP	RCR07G6R8KS	01121
R3	0076280	RESISTOR 6.8 OHM 1/4W 10% COMP	RCR07G6R8KS	01121
R4	0076280	RESISTOR 6.8 OHM 1/4W 10% COMP	RCR07G6R8KS	01121
R5	0076280	RESISTOR 6.8 OHM 1/4W 10% COMP	RCR07G6R8KS	01121
R6	0076280	RESISTOR 6.8 OHM 1/4W 10% COMP	RCR07G6R8KS	01121
R7	0076280	RESISTOR 6.8 OHM 1/4W 10% COMP	RCR07G6R8KS	01121
R8	0076280	RESISTOR 6.8 OHM 1/4W 10% COMP	RCR07G6R8KS	01121
R9	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
S1	0089610	SWITCH PUSHB DPDT MOM	K40152AA	
S2	0089610	SWITCH PUSHB DPDT MOM	K40152AA	
S3	0089610	SWITCH PUSHB DPDT MOM	K40152AA	
S4	0089610	SWITCH PUSHB DPDT MOM	K40152AA	
S5	0089610	SWITCH PUSHB DPDT MOM	K40152AA	
S6	0089610	SWITCH PUSHB DPDT MOM	K40152AA	
S7	0089610	SWITCH PUSHB DPDT MOM	K40152AA	
S8	0089610	SWITCH PUSHB DPDT MOM	K40152AA	
S9	0089610	SWITCH PUSHB DPDT MOM	K40152AA	
S10	0089610	SWITCH PUSHB DPDT MOM	K40152AA	
S11	0089610	SWITCH PUSHB DPDT MOM	K40152AA	
S12	0089610	SWITCH PUSHB DPDT MOM	K40152AA	
S13	0089610	SWITCH PUSHB DPDT MOM	K40152AA	
S14	0089610	SWITCH PUSHB DPDT MOM	K40152AA	
S15	0089610	SWITCH PUSHB DPDT MOM	K40152AA	
S16	0089610	SWITCH PUSHB DPDT MOM	K40152AA	
S17	0089610	SWITCH PUSHB DPDT MOM	K40152AA	
S18	0089610	SWITCH PUSHB DPDT MOM	K40152AA	
S19	0089610	SWITCH PUSHB DPDT MOM	K40152AA	
S20	0089610	SWITCH PUSHB DPDT MOM	K40152AA	
XA2P1	0084571	CONN 28 PIN FEM DOUBLE ROW BOTTOM MT	86418-3	00779
XA2P2	0085182	CONN 20-PIN FEM DOUBLE ROW BOTTOM MT	86418-1	00779
XA2P3	0085182	CONN 20-PIN FEM DOUBLE ROW BOTTOM MT	86418-1	00779
XA2P4	0084571	CONN 28 PIN FEM DOUBLE ROW BOTTOM MT	86418-3	00779
XA2P5	0085182	CONN 20-PIN FEM DOUBLE ROW BOTTOM MT	86418-1	00779
XA3P1	0084571	CONN 28 PIN FEM DOUBLE ROW BOTTOM MT	86418-3	00779
XA4P1	0085182	CONN 20-PIN FEM DOUBLE ROW BOTTOM MT	86418-1	00779
XA4P2	0085182	CONN 20-PIN FEM DOUBLE ROW BOTTOM MT	86418-1	00779
XA4P3	0084571	CONN 28 PIN FEM DOUBLE ROW BOTTOM MT	86418-3	00779
XA4P4	0085182	CONN 20-PIN FEM DOUBLE ROW BOTTOM MT	86418-1	00779

ANALYZER FRONT PANEL DISPLAY PWB ASSEMBLY - 304169
REF DESIGNATION PREFIX: 4654A-A14A2

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
CR1	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR2	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR3	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR4	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR5	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR6	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR7	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR8	0089614	LAMP LED RED .123 DIA .105 LNG 2.0V 20MA	MV5777C	
CR9	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR10	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR11	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR12	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR13	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR14	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR15	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR16	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR17	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR18	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR19	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR20	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR21	0171565	LAMP LED YEL .115 DIA .135 LNG 2.2V 10MA	HLMP-1402	
CR22	0171565	LAMP LED YEL .115 DIA .135 LNG 2.2V 10MA	HLMP-1402	
CR23	0171565	LAMP LED YEL .115 DIA .135 LNG 2.2V 10MA	HLMP-1402	
CR24	0171565	LAMP LED YEL .115 DIA .135 LNG 2.2V 10MA	HLMP-1402	
CR25	0089614	LAMP LED RED .123 DIA .105 LNG 2.0V 20MA	MV5777C	
CR26	0171565	LAMP LED YEL .115 DIA .135 LNG 2.2V 10MA	HLMP-1402	
CR27	0089614	LAMP LED RED .123 DIA .105 LNG 2.0V 20MA	MV5777C	
CR28	0171565	LAMP LED YEL .115 DIA .135 LNG 2.2V 10MA	HLMP-1402	
CR29	0089614	LAMP LED RED .123 DIA .105 LNG 2.0V 20MA	MV5777C	
CR30	0171565	LAMP LED YEL .115 DIA .135 LNG 2.2V 10MA	HLMP-1402	
CR31	0089614	LAMP LED RED .123 DIA .105 LNG 2.0V 20MA	MV5777C	
CR32	0171565	LAMP LED YEL .115 DIA .135 LNG 2.2V 10MA	HLMP-1402	
P1	0085128	CONN HEADER DBL ROW STRAIGHT 28-PIN PC	1-87227-4	00779
P2	0084930	CONN HEADER DBL ROW STRAIGHT 20-PIN PC	1-87227-0	00779
P3	0084930	CONN HEADER DBL ROW STRAIGHT 20-PIN PC	1-87227-0	00779
P4	0085128	CONN HEADER DBL ROW STRAIGHT 28-PIN PC	1-87227-4	00779
P5	0084930	CONN HEADER DBL ROW STRAIGHT 20-PIN PC	1-87227-0	00779
R1	0071901	RESISTOR 180 OHM 1/4W 10% COMP	RCR07G181KS	01121
R2	0071901	RESISTOR 180 OHM 1/4W 10% COMP	RCR07G181KS	01121
R3	0071901	RESISTOR 180 OHM 1/4W 10% COMP	RCR07G181KS	01121
R4	0071901	RESISTOR 180 OHM 1/4W 10% COMP	RCR07G181KS	01121
U1	0089678	DISPLAY LED 7 SEG RED RHDP .43 IN.	HDSP-3733	
U2	0089678	DISPLAY LED 7 SEG RED RHDP .43 IN.	HDSP-3733	
U3	0089678	DISPLAY LED 7 SEG RED RHDP .43 IN.	HDSP-3733	
U4	0089678	DISPLAY LED 7 SEG RED RHDP .43 IN.	HDSP-3733	
U5	0089678	DISPLAY LED 7 SEG RED RHDP .43 IN.	HDSP-3733	
U6	0089678	DISPLAY LED 7 SEG RED RHDP .43 IN.	HDSP-3733	
U7	0089678	DISPLAY LED 7 SEG RED RHDP .43 IN.	HDSP-3733	
U8	0088582	LAMP LED LIGHT BAR 2-SECT RED	HLMP-2300	
U9	0088582	LAMP LED LIGHT BAR 2-SECT RED	HLMP-2300	
U10	0089678	DISPLAY LED 7 SEG RED RHDP .43 IN.	HDSP-3733	
U11	0089678	DISPLAY LED 7 SEG RED RHDP .43 IN.	HDSP-3733	
U12	0089678	DISPLAY LED 7 SEG RED RHDP .43 IN.	HDSP-3733	
U13	0089678	DISPLAY LED 7 SEG RED RHDP .43 IN.	HDSP-3733	
U14	0089678	DISPLAY LED 7 SEG RED RHDP .43 IN.	HDSP-3733	
U15	0089678	DISPLAY LED 7 SEG RED RHDP .43 IN.	HDSP-3733	

ANALYZER FRONT PANEL INDICATOR ASSEMBLY - 304171
REF DESIGNATION PREFIX: 4654A-A14A3

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
CR1	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR2	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR3	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR4	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR5	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR6	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR7	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR8	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR9	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR10	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR11	0171565	LAMP LED YEL .115 DIA .135 LNG 2.2V 10MA	HLMP-1402	
CR12	0089614	LAMP LED RED .123 DIA .105 LNG 2.0V 20MA	MV5777C	
CR13	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR14	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR15	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR16	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR17	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR18	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR19	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR20	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR21	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR22	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR23	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
CR24	0171535	LAMP LED GRN .115 DIA..135 LNG 2.5V 30MA	HLMP-1523	
P1	0085128	CONN HEADER DBL ROW STRAIGHT 28-PIN PC	1-87227-4	00779

ANALYZER FRONT PANEL I/O ASSEMBLY - 304167
REF DESIGNATION PREFIX: 4654A-A14A4

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
C1	0170208	CAPACITR 4700 MF 10V	500D478M01GK2	
C2	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C3	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C4	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C5	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C6	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C7	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C8	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C9	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C10	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C11	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C12	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C13	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C14	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C15	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
CR1	0078600	NOT ASSIGNED	FOR ENG ONLY	
CR2	0078600	NOT ASSIGNED	FOR ENG ONLY	
CR3	0078600	NOT ASSIGNED	FOR ENG ONLY	
CR4	0078600	NOT ASSIGNED	FOR ENG ONLY	
CR5	0078600	NOT ASSIGNED	FOR ENG ONLY	
CR6	0078600	NOT ASSIGNED	FOR ENG ONLY	
CR7	0078600	NOT ASSIGNED	FOR ENG ONLY	
CR8	0078600	NOT ASSIGNED	FOR ENG ONLY	
J1	0171871	CONN HEADER DBL ROW STRAIGHT 50-PIN PC	3433-2002	
J2	0078600	NOT ASSIGNED	FOR ENG ONLY	
L1	0081740	INDUCTOR 250 UH FILTER CHOKE 1.3A	6310-9	04213
P1	0084930	CONN HEADER DBL ROW STRAIGHT 20-PIN PC	1-87227-0	00779
P2	0084930	CONN HEADER DBL ROW STRAIGHT 20-PIN PC	1-87227-0	00779
P3	0085128	CONN HEADER DBL ROW STRAIGHT 28-PIN PC	1-87227-4	00779
P4	0084930	CONN HEADER DBL ROW STRAIGHT 20-PIN PC	1-87227-0	00779
Q1	0078600	NOT ASSIGNED	FOR ENG ONLY	
R1	0078600	NOT ASSIGNED	FOR ENG ONLY	
R2	0078600	NOT ASSIGNED	FOR ENG ONLY	
R3	0078600	NOT ASSIGNED	FOR ENG ONLY	
R4	0078600	NOT ASSIGNED	FOR ENG ONLY	
R5	0071977	RESISTOR 2.2K OHM 1/4W 10% COMP	RCR07G222KS	01121
U1	0088053	IC INTERFACE CPU TO KEYBOARD AND DISPLAY	P8279-5	
U2	0085943	IC TTL DECODER 3-BIT TO 1 OF 8	SN74LS138N	
U3	0086205	IC TTL BUFFER INVERT OCTAL 3-STATE	SN74LS240N	
U4	0085943	IC TTL DECODER 3-BIT TO 1 OF 8	SN74LS138N	
U5	0083621	IC CMOS DECODER BCD TO DEC OR BIN/OCTL	MC14028BCL	04713
U6	0083621	IC CMOS DECODER BCD TO DEC OR BIN/OCTL	MC14028BCL	04713
U7	0078600	NOT ASSIGNED	FOR ENG ONLY	
U8	0078600	NOT ASSIGNED	FOR ENG ONLY	
U9	0086205	IC TTL BUFFER INVERT OCTAL 3-STATE	SN74LS240N	
U10	0086899	RESISTOR NETWORK 9 3.3K OHM 2% 10 SIP	785-1-R3.3K	
U11	0087800	RESISTOR NETWORK 8 220 OHM 2% 16 DIP	898-3-R220	
U12	0078600	NOT ASSIGNED	FOR ENG ONLY	
U13	0089504	RESISTOR NETWORK 8 3.3K OHM 2% 16 DIP	4116R-001-332	
U14	0089504	RESISTOR NETWORK 8 3.3K OHM 2% 16 DIP	4116R-001-332	
U15	0078600	NOT ASSIGNED	FOR ENG ONLY	
U16	0085948	IC TTL FLIP-FLOP TYPE-D OCTAL	SN74LS377N	
U17	0085948	IC TTL FLIP-FLOP TYPE-D OCTAL	SN74LS377N	
U18	0085948	IC TTL FLIP-FLOP TYPE-D OCTAL	SN74LS377N	
U19	0087800	RESISTOR NETWORK 8 220 OHM 2% 16 DIP	898-3-R220	
U20	0087800	RESISTOR NETWORK 8 220 OHM 2% 16 DIP	898-3-R220	
U21	0087800	RESISTOR NETWORK 8 220 OHM 2% 16 DIP	898-3-R220	
U22	0171539	RESISTOR NETWORK 5 3.3K OHM 2% 6 SIP	4306R-101-332	
U23	0078600	NOT ASSIGNED	FOR ENG ONLY	
U24	0078600	NOT ASSIGNED	FOR ENG ONLY	
U25	0085948	IC TTL FLIP-FLOP TYPE-D OCTAL	SN74LS377N	
U26	0085946	IC TTL GATE NAND 3-IN TRIPLE	SN74LS10N	
U27	0085948	IC TTL FLIP-FLOP TYPE-D OCTAL	SN74LS377N	

ANALYZER I/O FRONT PANEL ASSEMBLY - 304167 (continued)

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
U28	0087800	RESISTOR NETWORK 8 220 OHM 2% 16 DIP	898-3-R220	
U29	0087800	RESISTOR NETWORK 8 220 OHM 2% 16 DIP	898-3-R220	
XU1	0086653	SOCKET 40 PIN DIP PC MT	ICT-406-S-T	

ANALYZER REAR PANEL ASSEMBLY - 304183
(AC VERSION ONLY)
REF DESIGNATION PREFIX: 4654A-A15

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
2	0252744	AC PWR WIRING HARNESS BERTS		
4	0158002	B FILTER,FAN	PER S A DWG	
5	0158041	B RETAINER,SCREEN,MODEL 4647	PER S A DWG	
22	0077322	SCREW 4-40 X 1/4 PAN HD,TAPTITE,CAD PLT	BY DESCRIPTION	72228
26	0085868	INSULATOR MICA FOR TO-3 CASE	B52600F011	
27	0252778	C PWR REGULATOR WIR HARNESS BERT		
B1	0076321	FAN 3 IN. SPRITE 115VAC 50/60 HZ	SU2A5	82877
T1	0252727	TRANSFORMER,POWER BERTS	EP5672 QUOTE A9793	
U1	0087844	IC VLTG RGLTR +1.2 TO +37V .8A TYP TO3	ULM317K	
U2	0088335	IC VLTG RGLTR -1.2 TO -37V .8A TYP TO3	LM337K	
U3	0170316	IC VLTG RGLTR +1.2 TO +32V 5A TYP TO3	LM338K	

ANALYZER REAR PANEL ASSEMBLY - 304184
(AC/DC VERSION ONLY)
REF DESIGNATION PREFIX: 4654A-A15

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
2	0252782	PWR WIRING HARNESS AC/DC BERTS		
4	0158002	B FILTER,FAN	PER S A DWG	
5	0158041	B RETAINER,SCREEN,MODEL 4647	PER S A DWG	
22	0071222	FUSE 1 1/2 AMP SLO BLO	3AG 31301.5	75915
24	0079833	GUARD FINGER FAN	20049	82877
29	0252767	D FLX CKT ASY AUX INTFC RCVR4654		
31	0252791	A CBL ASSY DEMUX CONT I/O 4654		
32	0220983	C CBL ASSY LOCAL PRINTER INTERF		
A1	0252781	E PWB ASSY RECTIFIER&FLTR AC/DC		
B1	0220951	FAN ASSY SERIES 4650		
T1	0252727	TRANSFORMER,POWER BERTS	EP5672 QUOTE A9793	

ANALYZER RECTIFIER AND FILTER ASSEMBLY - 252781
(AC/DC VERSION ONLY)
REF DESIGNATION PREFIX: 4654A-A15A1

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
2	0081453	FUS HLDR CLIP FOR 3AG OR 3AB PC MT 2 PIN	798	79963
9	0077828	INSULATR THERMA-FILM FOR TO-3 TRANSISTOR	43-03-4	13103
C1	0075417	CAPACITR .01 MF 150V CER DISC Z5V-40+60%	DDM-103	71590
C2	0089646	CAPACITR 33 MF 100V	672D336H100EK5C	
C3	0089646	CAPACITR 33 MF 100V	672D336H100EK5C	
C4	0171550	CAPACITR 1600 MF 75V	3050HP162U075JM	
C5	0171550	CAPACITR 1600 MF 75V	3050HP162U075JM	
C6	0170264	CAPACITR 1 MF 100V CER MONO 651 20%	8141-100-651-105M	
CR1	0081865	DIODE 1N4999 SIL 200V 3A PC MOUNT	1N4999	04713
CR2	0089680	RECTIFIER ASSY 200V 10A	PY20-WIRE LEADS	
CR3	0089680	RECTIFIER ASSY 200V 10A	PY20-WIRE LEADS	
CR4	0083986	DIODE 1N4746A SI ZEN 18V 5% 1W	1N4746A	04713
F1	0071232	FUSE 5 AMP SLO BLO	3AG 313005.	75915
F2	0071236	FUSE 10 AMP 250 VOLT	3AB 314010.	75915
J1	0089690	CONN RECT SOCKET HEADER ASSY 3 CIRCUITS	350760-4	
J2	0082769	CONN RECT PIN HEADER PC BD 6 CIRCUIT	1-380999-0	00779
J3	0087351	CONN RECT PIN HEADER PC BD 2 CIRCUIT	350539-2	
L1	0170266	INDUCTOR 47 UH CHOKE 4 AMPS	RL-1283-47	
L2	0170266	INDUCTOR 47 UH CHOKE 4 AMPS	RL-1283-47	
Q1	0089669	TRANSSTR IRF132 FET N-CHNL MOS POWER	IRF132	
R1	0072214	RESISTOR 4.7 MEG 1/4W 10% COMP	RCR07G475KS	01121

ANALYZER POWER WIRING HARNESS - 252751
(AC VERSION ONLY)

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
1	0086010	CONN CONTACT #18-22AWG FEM GOLD PLATE	60617-5	
2	0089565	CONN CONTACT RECEPTACLE #18-22AWG	87027-3	
3	0087429	PLUG KEYING FOR SA #87427	87116-2	
P1	0087046	CONN RECT SOC HOUSING FREE HANG 10 CIR	1-480285-0	
P2	0089674	CONN HEADER HOUSING 12 PIN SGL ROW	1-87025-1	

ANALYZER POWER WIRING HARNESS - 220947
(AC/DC VERSION ONLY)

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
1	0086010	CONN CONTACT #18-22AWG FEM GOLD PLATE	60617-5	
2	0089565	CONN CONTACT RECEPTACLE #18-22AWG	87027-3	
3	0087429	PLUG KEYING FOR SA #87427	87116-2	
P1	0087046	CONN RECT SOC HOUSING FREE HANG 10 CIR	1-480285-0	
P2	0170256	CONN RECT SOC HOUSING 10 CIRCUIT RED	1-480285-2	
P3	0087352	CONN RECT SOC HOUSING POS LOCK 2 CIRCUIT	1-480720-0	
P4	0089674	CONN HEADER HOUSING 12 PIN SGL ROW	1-87025-1	

ANALYZER CABLE ASSEMBLY DEMUX CONTROL I/O - 252791

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
1	0082495	CABLE FLAT 26-COND. 28 AWG	3365/26	76381
2	0083300	PLUG KEYING	86286-1	00779
P1	0086241	CONN 25 PIN MALE TO 26 COND FLAT CBL	206771-1	
P2	0170223	CONN FLAT CABLE 26 PIN FEM	88377-5	

ANALYZER CABLE ASSEMBLY-LOCAL PRINTER INTERFACE - 220983

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
1	0084305	CABLE FLAT 50-COND. 28 AWG	3365/50	76381
2	0076216	TAPE SPR 3/16THK X 1. W ADHSV	RH 761 50 PS	83797
3	0076216	TAPE SPR 3/16THK X 1. W ADHSV	RH 761 50 PS	83797
P1	0171595	CONN MISC FLT CBL 50 COND FEM	3565-1000	
P2	0087029	CONN FLAT CABLE 50 PIN	86916-2	
P3	0085048	CONN FLAT CABLE 10 PIN FEM W/STRN RELIEF	86981-2	00779

ANALYZER IEEE-488 INTERFACE OPTION: 304208
REF DESIGNATION PREFIX: 4654A-1

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
1	0170257	CONN RECT JACK SCKT HDWR RIGHT ANGLE MT	552633-3	
2	0220981	CBL ASY IEEE-488 INTERFACE4652		
A3	0255471	PWB ASSY INTERFACE IEEE BUS		

ANALYZER IEEE-488 INTERFACE OPTION PWB ASSEMBLY - 255471
REF DESIGNATION PREFIX: 4654A-1/A3

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
U5	0086900	IC BUS TRANSCVR IEEE 488 INTERFACE	MC68488L	
		SUBASSEMBLY - 221272		
C1	0070651	CAPACITR 25 MF 25V	500D256G025CB7	80183
C2	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C3	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C4	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C5	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C6	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C7	0081995	CAPACITR .001 MF 100V CER MONO X7R 10%	8121-100-X7R-102K	72982
C8	0081995	CAPACITR .001 MF 100V CER MONO X7R 10%	8121-100-X7R-102K	72982
C9	0084214	CAPACITR .0015 MF 100V CER MONO X7R 10%	8121-100-X7R-152K	72982
C10	0070544	CAPACITR .001 MF 1KV CER DISC Z5F 10%	DD102	71590
C11	0077583	CAPACITR 390 PF 1KV CER DISC Z5F 10%	DD391	71590
C12	0077583	CAPACITR 390 PF 1KV CER DISC Z5F 10%	DD391	71590
C13	0070519	CAPACITR 120 PF 500V SILVER MICA 5%	CD15FD121J03	14655
J1	0078600	NOT ASSIGNED	FOR ENG ONLY	
J2	0089595	CONN HEADER DBL ROW RT ANGLE 24-PIN PC	1-87230-2	
J3	0087229	CONN HEADER SGL ROW STRAIGHT 2-PIN PC	87220-2	
L1	0078716	INDUCTOR 100 UH SUBMIN UNSHLD 10%	IR-2	91637
L2	0078716	INDUCTOR 100 UH SUBMIN UNSHLD 10%	IR-2	91637
P1	0086100	PWB PRINTED COMPONENT	PER S A DWG	
P2	0078600	NOT ASSIGNED	FOR ENG ONLY	
P3	0086884	JUMPER FEMALE INSULATED .10 SPACING	65474-004	
Q1	0077147	TRANSSTR 2N3947 NPN SIL	2N3947	04713
Q2	0077147	TRANSSTR 2N3947 NPN SIL	2N3947	04713
Q3	0079490	TRANSSTR 2N2369A NPN SIL SWITCHING	2N2369A	79089
Q4	0079490	TRANSSTR 2N2369A NPN SIL SWITCHING	2N2369A	79089
R1	0071989	RESISTOR 3.3K OHM 1/4W 10% COMP	RCR07G332KS	01121
R2	0071989	RESISTOR 3.3K OHM 1/4W 10% COMP	RCR07G332KS	01121
R3	0071989	RESISTOR 3.3K OHM 1/4W 10% COMP	RCR07G332KS	01121
R4	0071951	RESISTOR 1.0K OHM 1/4W 10% COMP	RCR07G102KS	01121
R5	0071989	RESISTOR 3.3K OHM 1/4W 10% COMP	RCR07G332KS	01121
R6	0071989	RESISTOR 3.3K OHM 1/4W 10% COMP	RCR07G332KS	01121
R7	0071977	RESISTOR 2.2K OHM 1/4W 10% COMP	RCR07G222KS	01121
R8	0071989	RESISTOR 3.3K OHM 1/4W 10% COMP	RCR07G332KS	01121
R9	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R10	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R11	0071993	RESISTOR 3.9K OHM 1/4W 10% COMP	RCR07G392KS	01121
R12	0071989	RESISTOR 3.3K OHM 1/4W 10% COMP	RCR07G332KS	01121
R13	0071951	RESISTOR 1.0K OHM 1/4W 10% COMP	RCR07G102KS	01121
R14	0071966	RESISTOR 1.5K OHM 1/4W 10% COMP	RCR07G152KS	01121
R15	0072002	RESISTOR 4.7K OHM 1/4W 10% COMP	RCR07G472KS	01121
R16	0072002	RESISTOR 4.7K OHM 1/4W 10% COMP	RCR07G472KS	01121
R17	0071977	RESISTOR 2.2K OHM 1/4W 10% COMP	RCR07G222KS	01121
R18	0071989	RESISTOR 3.3K OHM 1/4W 10% COMP	RCR07G332KS	01121
R19	0072054	RESISTOR 22K OHM 1/4W 10% COMP	RCR07G223KS	01121
S1	0083296	SWITCH SPST 8 POS PC MT DIP	435166-5	00779
U1	0086901	IC BUS TRANSCVR IEEE 488 INTERFACE	MC3448P	
U2	0086901	IC BUS TRANSCVR IEEE 488 INTERFACE	MC3448P	
U3	0086901	IC BUS TRANSCVR IEEE 488 INTERFACE	MC3448P	
U4	0086901	IC BUS TRANSCVR IEEE 488 INTERFACE	MC3448P	
U5	0086900	IC BUS TRANSCVR IEEE 488 INTERFACE	MC68488L	
U6	0085949	IC TTL BUFFER OCTAL 3-STATE	SN74LS244N	
U7	0086898	IC BUS TRANSCVR 8-BIT	SN74LS245N	
U8	0080979	IC TTL BUFFER INVERT HEX OPEN-COL	SN7406N	01295
U9	0085943	IC TTL DECODER 3-BIT TO 1 OF 8	SN74LS138N	
U10	0085943	IC TTL DECODER 3-BIT TO 1 OF 8	SN74LS138N	
U11	0084283	IC TTL FLIP-FLOP TYPE-D DUAL	SN74LS74AN	01295
U12	0084284	IC TTL GATE NOR 3-IN TRIPLE	SN74LS27N	01295
U13	0086899	RESISTOR NETWORK 9 3.3K OHM 2% 10 SIP	785-1-R3.3K	
U14	0084279	IC TTL GATE NAND 2-IN QUAD	SN74LS00N	01295
U15	0085946	IC TTL GATE NAND 3-IN TRIPLE	SN74LS10N	

ANALYZER IEEE-488 INTERFACE OPTION ASSEMBLY - 255471 (continued)

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
XS1	0086649	SOCKET 16 PIN DIP PC MT	ICT-163-S-T	
XU1	0086649	SOCKET 16 PIN DIP PC MT	ICT-163-S-T	
XU2	0086649	SOCKET 16 PIN DIP PC MT	ICT-163-S-T	
XU3	0086649	SOCKET 16 PIN DIP PC MT	ICT-163-S-T	
XU4	0086649	SOCKET 16 PIN DIP PC MT	ICT-163-S-T	
XU5	0086653	SOCKET 40 PIN DIP PC MT	ICT-406-S-T	
XU6	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU7	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU8	0086648	SOCKET 14 PIN DIP PC MT	ICT-143-S-T	
XU9	0086649	SOCKET 16 PIN DIP PC MT	ICT-163-S-T	
XU10	0086649	SOCKET 16 PIN DIP PC MT	ICT-163-S-T	
XU11	0086648	SOCKET 14 PIN DIP PC MT	ICT-143-S-T	
XU12	0086648	SOCKET 14 PIN DIP PC MT	ICT-143-S-T	
XU14	0086648	SOCKET 14 PIN DIP PC MT	ICT-143-S-T	
XU15	0086648	SOCKET 14 PIN DIP PC MT	ICT-143-S-T	

ANALYZER RS-232C INTERFACE OPTION - 304209
REF DESIGNATION PREFIX: 4654A-2

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
1	0084646	CONN SCREWLOCK ASSY FEMALE	205817-1	00779
2	0220982	CBL ASSY RS-232 INTERFACE 4652		
A3	0221026	A PWB ASY SER I/O INTERRUPT CONT		

ANALYZER RS-232C INTERFACE OPTION PWB ASSEMBLY - 221026
REF DESIGNATION PREFIX: 4654A-2/A3

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
C1	0070651	CAPACITR 25 MF 25V	500D256G025CB7	80183
C2	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C3	0070651	CAPACITR 25 MF 25V	500D256G025CB7	80183
C4	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C5	0070651	CAPACITR 25 MF 25V	500D256G025CB7	80183
C6	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C7	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C9	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
J1	0087031	CONN HEADER DBL ROW RT ANGLE 26-PIN PC	87476-3	
R1	0074722	RESISTOR 4.7K OHM 1/4W 5% COMP	RCR07G472JS	01121
R2	0074722	RESISTOR 4.7K OHM 1/4W 5% COMP	RCR07G472JS	01121
U1	0086788	CAPACITR NTWK 7-390PF 100V 10% CER 8 SIP	460CH391X9PD	
U2	0087083	IC DTL LINE DRIVER QUAD	MC1488L	
U3	0087084	IC DTL LINE RECEIVER QUAD	MC1489L	
U4	0087085	RESISTOR NETWORK 7 3.9K OHM 2% 8 SIP	764-1-R3.9K	
U5	0087088	RESISTOR NETWORK 7 39K OHM 2% 8 SIP	764-1-R39K	
U6	0087089	CAPACITR NTWK 7-.001MF 100V 20% CER 8SIP	460CH102X0PD	
U7	0080979	IC TTL BUFFER INVERT HEX OPEN-COL	SN7406N	01295
U8	0085943	IC TTL DECODER 3-BIT TO 1 OF 8	SN74LS138N	
U9	0087086	RESISTOR NETWORK 7 4.7K OHM 2% 8 SIP	4308R-101-472	
U10	0087090	IC TTL GATE AND 4-IN DUAL	SN74LS21N	
U11	0170265	IC COMM INTERFACE USART PROGRAMMABLE	D8251A	
U12	0086790	IC TIMER PROGRAMMABLE INTERVAL	D8253	
U13	0087087	RESISTOR NETWORK 7 10K OHM 2% 8 SIP	764-1-R10K	
U22	0086898	IC BUS TRANSCVR 8-BIT	SN74LS245N	
U23	0084282	IC TTL GATE AND 2-IN QUAD	SN74LS08N	01295
U24	0087456	IC TTL MULTIPLIER RATE DECADE	SN74167N	
U25	0087086	RESISTOR NETWORK 7 4.7K OHM 2% 8 SIP	4308R-101-472	
XU2	0086648	SOCKET 14 PIN DIP PC MT	ICT-143-S-T	
XU3	0086648	SOCKET 14 PIN DIP PC MT	ICT-143-S-T	
XU7	0086648	SOCKET 14 PIN DIP PC MT	ICT-143-S-T	
XU8	0086649	SOCKET 16 PIN DIP PC MT	ICT-163-S-T	
XU10	0086648	SOCKET 14 PIN DIP PC MT	ICT-143-S-T	
XU11	0086652	SOCKET 28 PIN DIP PC MT	ICT-286-S-TG30	
XU12	0086651	SOCKET 24 PIN DIP PC MT	ICT-246-S-T	
XU22	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU23	0086648	SOCKET 14 PIN DIP PC MT	ICT-143-S-T	
XU24	0086649	SOCKET 16 PIN DIP PC MT	ICT-163-S-T	

ANALYZER EXTERNAL MONITOR OPTION - 304210
REF DESIGNATION PREFIX: 4654A-3

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
1	0304185	CBL ASSY DCV/ALARM REAR PNL		
2	0074046	CONN RECT SLIDING LOCK POST	CE-D53018	71468
3	0252859	CABLE ASSY-DCV/ALARM MON		
A4	0304372	PWB ASSY EXT EVENT MON 4654A		

ANALYZER EXTERNAL MONITOR OPTION PWB ASSEMBLY - 313109
REF DESIGNATION PREFIX: 4654A-3/A4

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
1	0304148	PWB SUBASSY EXT/EVENT MON4654A		
2	0313110	EPROM AND LABEL ASSY MON 4654A		
		Subassembly - 304148		
C1	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C2	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C3	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C4	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C5	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C6	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C7	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C8	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C9	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C10	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C11	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C12	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C13	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C14	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C15	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C16	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C17	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C18	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C19	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C20	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C21	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C22	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C23	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C24	0087126	CAPACITR 1 MF 100V MET POLYESTER 10%	B32571-1/10/100	
C25	0087126	CAPACITR 1 MF 100V MET POLYESTER 10%	B32571-1/10/100	
C26	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C27	0087126	CAPACITR 1 MF 100V MET POLYESTER 10%	B32571-1/10/100	
CR1	0071142	DIODE 1N4154 SIL 25V 150MA	1N4154	80368
CR2	0071142	DIODE 1N4154 SIL 25V 150MA	1N4154	80368
CR3	0071142	DIODE 1N4154 SIL 25V 150MA	1N4154	80368
CR4	0071142	DIODE 1N4154 SIL 25V 150MA	1N4154	80368
J1	0084585	CONN HEADER DBL ROW RT ANGLE 10-PIN PC	87230-5	00779
L1	0079926	INDUCTOR 10 UH SUBMIN UNSHLD 10%	IR-2	91637
L2	0079926	INDUCTOR 10 UH SUBMIN UNSHLD 10%	IR-2	91637
Q1	0081544	TRANSSTR 2N4856 SIL FET N-CHNL JUNC	2N4856	01295
Q2	0081544	TRANSSTR 2N4856 SIL FET N-CHNL JUNC	2N4856	01295
R1	0071887	RESISTOR 100 OHM 1/4W 10% COMP	RCR07G101KS	01121
R2	0071887	RESISTOR 100 OHM 1/4W 10% COMP	RCR07G101KS	01121
R3	0171582	RESISTOR 49.9K OHM RN55C	RN55C4992B	
R4	0071887	RESISTOR 100 OHM 1/4W 10% COMP	RCR07G101KS	01121
R5	0171582	RESISTOR 49.9K OHM RN55C	RN55C4992B	
R6	0071887	RESISTOR 100 OHM 1/4W 10% COMP	RCR07G101KS	01121
R7	0072019	RESISTOR 8.2K OHM 1/4W 10% COMP	RCR07G822KS	01121
R8	0171582	RESISTOR 49.9K OHM RN55C	RN55C4992B	
R9	0072019	RESISTOR 8.2K OHM 1/4W 10% COMP	RCR07G822KS	01121
R10	0072019	RESISTOR 8.2K OHM 1/4W 10% COMP	RCR07G822KS	01121
R11	0072002	RESISTOR 4.7K OHM 1/4W 10% COMP	RCR07G472KS	01121
R12	0171582	RESISTOR 49.9K OHM RN55C	RN55C4992B	
R13	0072002	RESISTOR 4.7K OHM 1/4W 10% COMP	RCR07G472KS	01121
R14	0072019	RESISTOR 8.2K OHM 1/4W 10% COMP	RCR07G822KS	01121
R15	0072002	RESISTOR 4.7K OHM 1/4W 10% COMP	RCR07G472KS	01121
R16	0072019	RESISTOR 8.2K OHM 1/4W 10% COMP	RCR07G822KS	01121
R17	0072019	RESISTOR 8.2K OHM 1/4W 10% COMP	RCR07G822KS	01121
R18	0072019	RESISTOR 8.2K OHM 1/4W 10% COMP	RCR07G822KS	01121
R19	0083902	RESISTOR 3.01K OHM RN55C 1% MTL FLM	RN55C3011F	
R20	0078929	RESISTOR 1.00K OHM RN55C 1% MTL FLM	RN55C1001F	
R21	0078929	RESISTOR 1.00K OHM RN55C 1% MTL FLM	RN55C1001F	
R22	0089522	POT 100K OHM 1/2W CER 3/8 SQ VER ADJ 25T	3299W-1-104	
R23	0083891	RESISTOR 1.50K OHM RN55C 1% MTL FLM	RN55C1501F	

ANALYZER EXTERNAL MONITOR OPTION - 313109 (continued)

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
R24	0071907	RESISTOR 220 OHM 1/4W 10% COMP	RCR07G221KS	01121
R25	0083929	RESISTOR 30.1K OHM RN55C 1% MTL FLM	RN55C3012F	
R26	0072019	RESISTOR 8.2K OHM 1/4W 10% COMP	RCR07G822KS	01121
R27	0079744	RESISTOR 7.50K OHM RN55C 1% MTL FLM	RN55C7501F	
R28	0087839	POT 5K OHM 1/2 CER 3/8 SQ VERT ADJ 25T	3299W-1-502	
U1	0085943	IC TTL DECODER 3-BIT TO 1 OF 8	SN74LS138N	
U2	0171581	IC CMOS RAM 2048X8 200 NS STATIC	HM6116L-4	
U4	0084285	IC TTL GATE OR 2-IN QUAD	SN74LS32N	01295
U5	0086646	IC TTL DECODER 2-BIT TO 1 OF 4 DUAL	SN74LS139N	
U6	0084282	IC TTL GATE AND 2-IN QUAD	SN74LS08N	01295
U7	0086898	IC BUS TRANSCVR 8-BIT	SN74LS245N	
U8	0086646	IC TTL DECODER 2-BIT TO 1 OF 4 DUAL	SN74LS139N	
U9	0085948	IC TTL FLIP-FLOP TYPE-D OCTAL	SN74LS377N	
U10	0089527	IC TTL COUNTER DECADE 35-MHZ 2X5 DUAL	SN74LS390N	
U11	0084280	IC TTL GATE NOR 2-IN QUAD	SN74LS02N	01295
U12	0087981	IC TTL BUFFER QUAD 3-STATE	SN74LS125N	
U13	0084280	IC TTL GATE NOR 2-IN QUAD	SN74LS02N	01295
U14	0089590	RESISTOR NETWORK 5 4.7K OHM 2% 6 SIP	4306R-101-472	
U15	0083240	IC COMPARATOR-VOLTAGE 14L-DIP QUAD	LM339N	12040
U16	0170249	IC OP AMP 8L-DIP 70C COMP LO OFFSET	OP-07CP	
U17	0171576	IC A/D CONVERTER 4 1/2 DIGIT DUAL SLOPE	TL500C	
U18	0171580	IC DIGITAL PROCESSOR W/H BCD DRIVERS	TL503CN	
U19	0171579	IC VOLTAGE REFERENCE 5.0V	MC1404AU5	
U20	0084509	IC TTL MULTIPLEXER 8-BIT/1-CHNL TO1 3STE	SN74LS251N	01295
U21	0087889	IC TTL FLIP-FLOP TYPE-D OCTAL 3-STATE	SN74LS374N	
U22	0089590	RESISTOR NETWORK 5 4.7K OHM 2% 6 SIP	4306R-101-472	
XU2	0086651	SOCKET 24 PIN DIP PC MT	ICT-246-S-T	
XU3	0086652	SOCKET 28 PIN DIP PC MT	ICT-286-S-TG30	
XU7	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU9	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU21	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	

ANALYZER OPTIONAL PRINTER ASSEMBLY - 221020
REF DESIGNATION PREFIX: 4654A-4

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
1	0220994	REV A PRINTER ASSY MODEL 4650		
2	0080499	TAPE PAPER WHITE FOR ADDING MACH 2 1/4 W	BY DESCRIPTION	
W1	0257126	CABLE ASSY,LOCAL PRINTER MODEL 4650	LAS27692	

ANALYZER OPTIONAL PRINTER ASSEMBLY MODEL 4650 - 220994

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
1	0221013	PRINTER DOT MATRIX SNK MDL DP-822		
2	0220987	BASE PRINTER ENCLOSURE MDL 4652-3	PER S A DWG	
3	0220986	COVER PRINTER ENCLOSURE MDL 4652-3	PER S A DWG	
4	0220991	D PNL FR PRINTER MDL4650		
5	0220988	RETAINER PAPER PRINTER MDL 4652-3	PER S A DWG	
6	0071288	GROMMET 1/8 ID 1/4 HOLE 1/16PNL SFT RUB	1665	73734
8	0158087	A BEZEL,SWITCH,MODEL 4647	PER S A DWG	
9	0170203	CONN RECT BAIL LOCK KIT ASSY	552561-3	
10	0089695	INSERT BANC-LOK 4-40 X .188 LG KNURLED	410440	
11	0088394	INSERT BANC-LOK 2-56 X .156 LG KNURLED	410256	
12	0220940	FOOT BUMPER	PER SA DWG	
24	0089611	PUSHBUTTON BLACK FOR SA PN 89610	B305BL	
25	0221015	GUIDE, PAPER MODEL 4652-3	4652-3	
A1	0221014	CONTROL/DRIVER PRINTER SNK MDL 822-08A	PER S A DWG	
A2	0221002	PWB ASSY PRINTER I/O 4652-3		
A3	0220999	FLEX PWB ASSY PRINTER 4652-3		
DS1	0170209	LAMP LED-RESISTOR GRN SNAP-IN 5V 15MA	558-0202-001	

ANALYZER OPTIONAL PRINTER - I/O INTERFACE PWB ASSEMBLY - 221002
REF DESIGNATION PREFIX: 4654A-4A2

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
C1	0171551	CAPACITOR 3800 MF 20V	3050 GP 382U 020 JM	
C2	0171551	CAPACITOR 3800 MF 20V	3050 GP 382U 020 JM	
C3	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C4	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
J1	0170202	CONN ASSY 16 PIN SINGLE ROW FEM PC MT	85928-8	
J2	0170201	CONN ASSY 11 PIN SINGLE ROW FEM PC MT	85928-3	
J3	0170200	CONN HEADER SGL ROW STRAIGHT 12-PIN PC	1-87220-2	
J4	0170204	CONN RECT 50-COND FEMALE RT ANGL MT	552725-1	
L1	0081740	INDUCTOR 250 UH FILTER CHOKE 1.3A	6310-9	04213
Q1	0077147	TRANSSTR 2N3947 NPN SIL	2N3947	04713
Q2	0077147	TRANSSTR 2N3947 NPN SIL	2N3947	04713
R1	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R2	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R3	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R4	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
S1	0170262	SWITCH MICRO SPDT PC MT 1.765 INCH LEVER	311SM703-H58	

ANALYZER OPTIONAL PRINTER ASSEMBLY FLEX PWB ASSEMBLY - 220999
REF DESIGNATION PREFIX: 4654A-4A3

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
J1	0170210	CONN FLAT CABLE 12 PIN FEM	65801-012	
S1	0220990	SWITCH ASSY PRINTER CONTROL MDL 4652-3	2LL90B02000046	

ANALYZER ACCESSORY KIT - 304178

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
1	0256027	INSTR MNL 4654A ERTS ANALYZER OPR'S		
2	0089672	CORD SET 3-WIRE #18 125V 9-FT W/RT ANG F	17746-YEL SHIELDED	
3	0071223	FUSE 2 AMP	3AG 312002.	75915
4	0071229	FUSE 4 AMP	3AG 312004.	75915
5	0071222	FUSE 1 1/2 AMP SLO BLO	3AG 31301.5	75915
6	0071232	FUSE 5 AMP SLO BLO	3AG 313005.	75915
7	0071236	FUSE 10 AMP 250 VOLT	3AB 314010.	75915
8	0087460	CONN CONTACT PIN FOR SA PN 87458	350547-2	
9	0089689	CONN RECT PLUG HOUSING 3 CIRCUITS	1-480700-0	

ANALYZER SERVICE ACCESSORY KIT - 304125

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
1	0221035	PWB ASSY EXTENDER CARD 4652		
2	0254439	CARD PULLER	PER S A DWG	
3	0256028	INSTR MNL 4654A ERTS ANALYZER MAINT	PER S A DWG	

CHAPTER 7
DIAGRAMS

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*AC Version Only
**AC/DC Version Only

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*AC Version Only
**AC/DC Version Only

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*AC Version Only
**AC/DC Version Only

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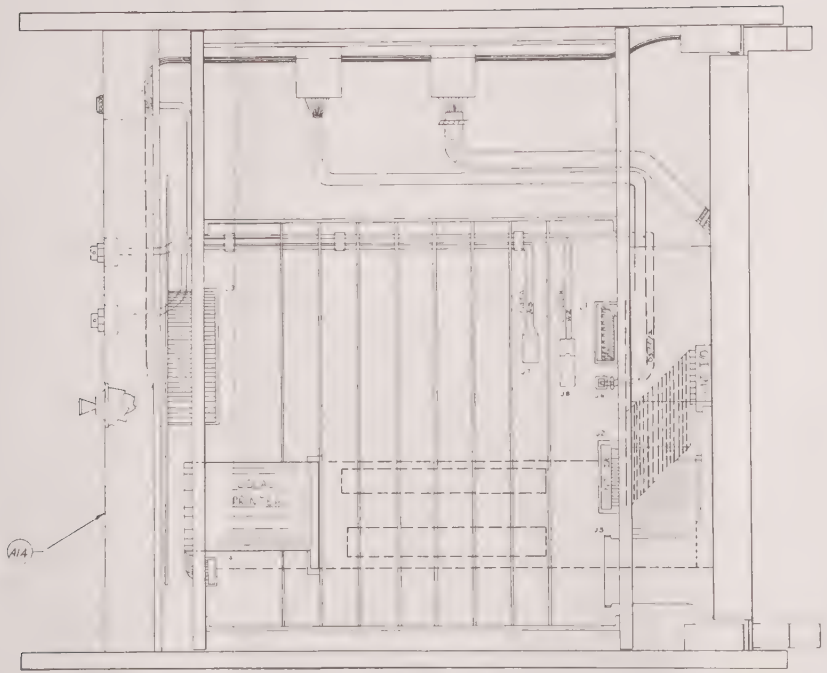


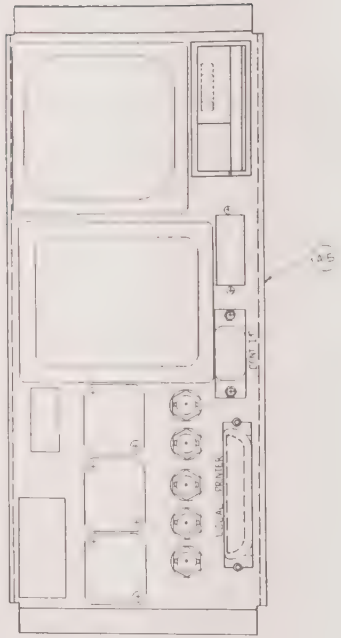
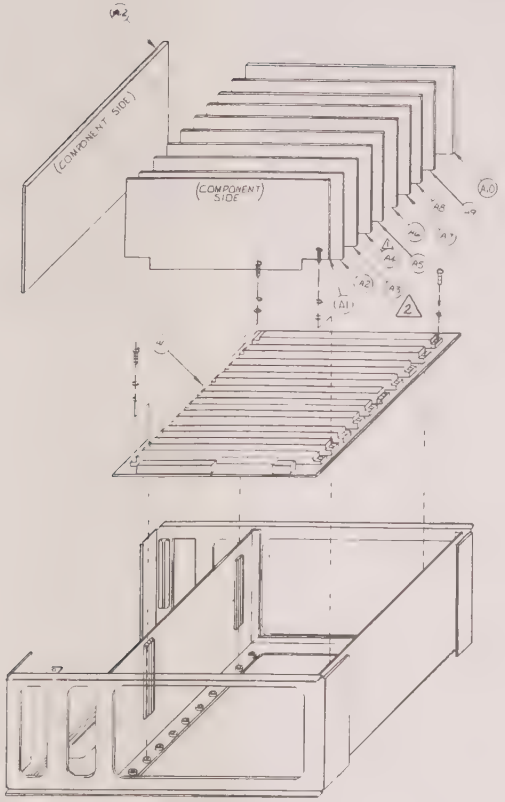


Figure 7.1. Analyzer Chassis Assembly Cable Installation Reference (AC Version Only), (Sheet 1 of 3)



NOTE:

1. OPTIONAL EXTERNAL EVENT MONITOR/MEMORY
2. OPTIONAL IEEE-488 OR RS-232

Figure 7.1. Analyzer Chassis Assembly Installation Reference (AC Version Only), (Sheet 2 of 3)

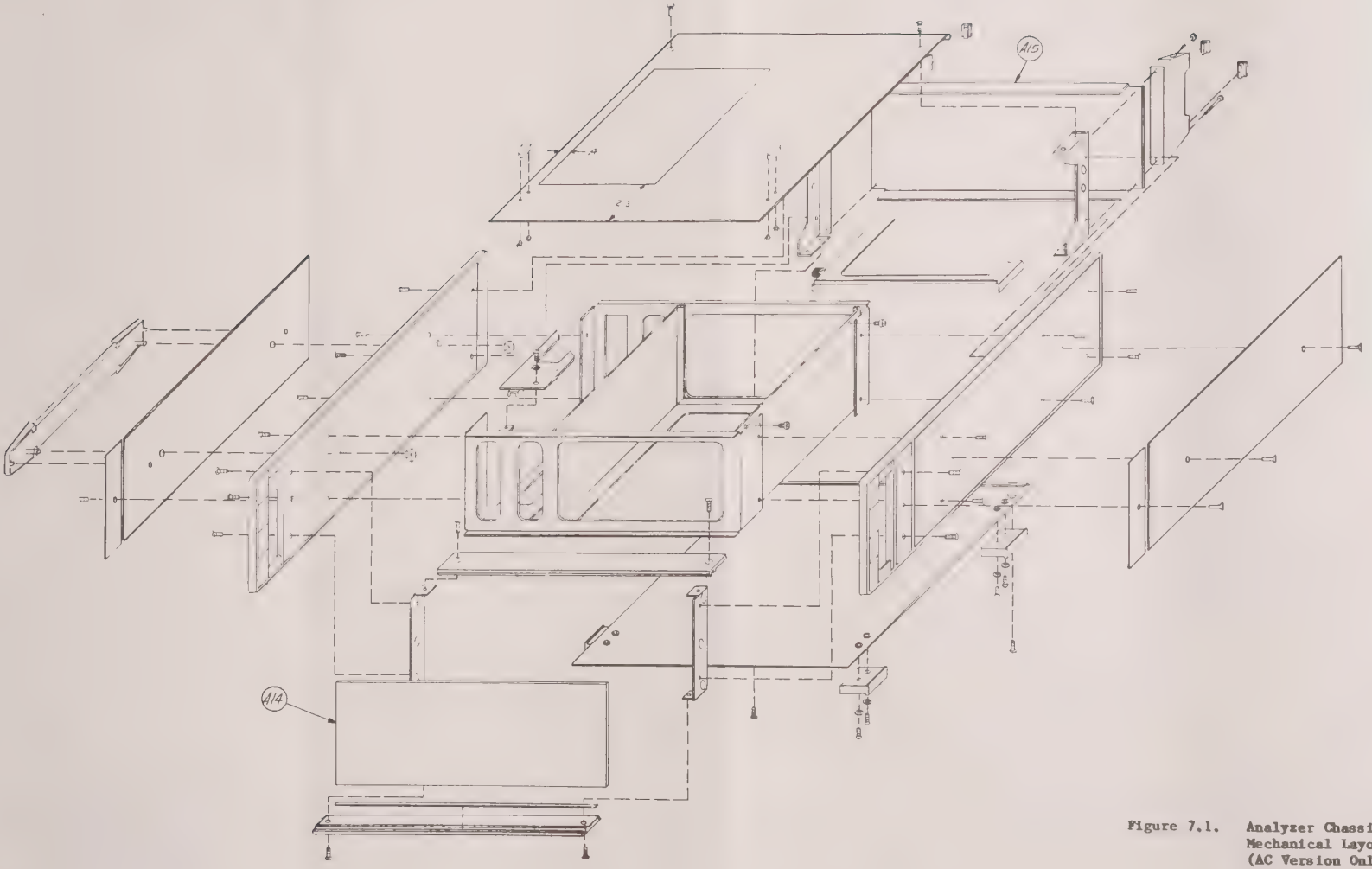


Figure 7.1. Analyzer Chassis Assembly Mechanical Layout (AC Version Only), (Sheet 3 of 3)

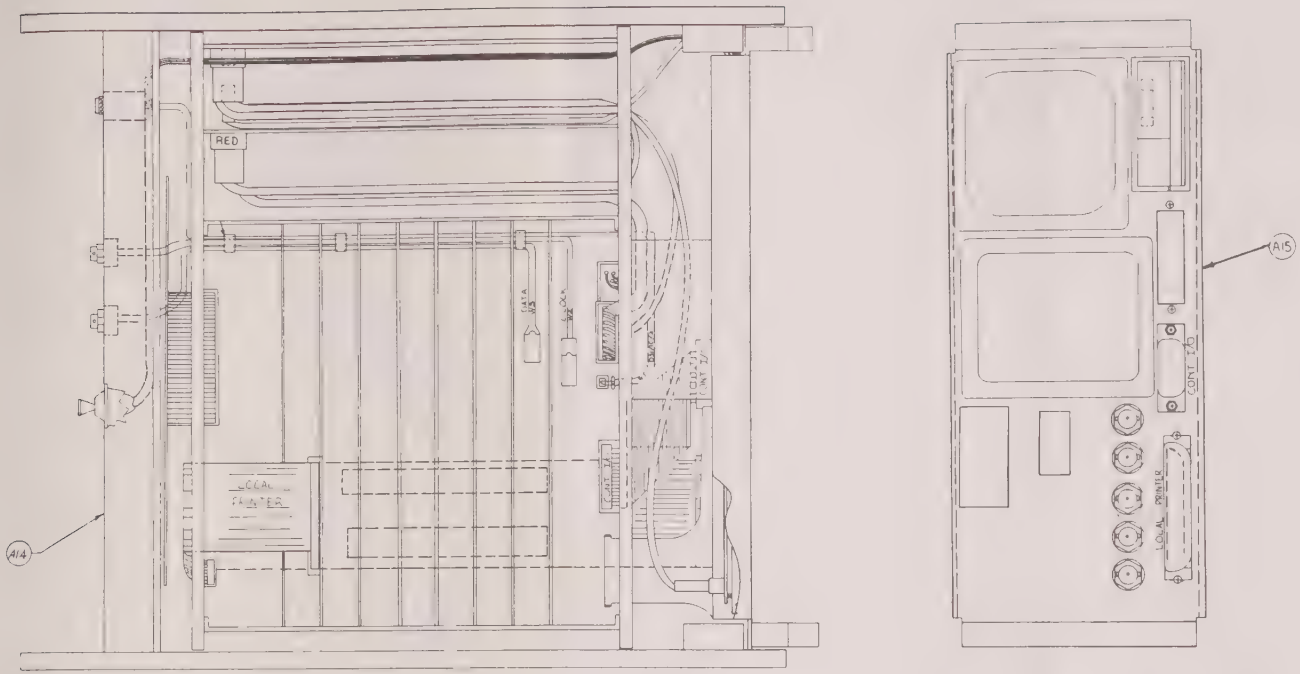
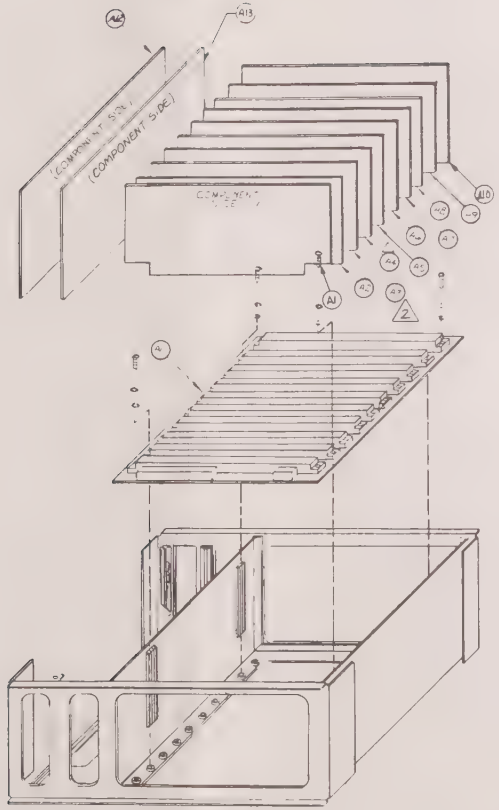


Figure 7.2. Analyzer Chassis Assembly Cable Installation Reference (AC/DC Version Only), (Sheet 1 of 3)



NOTE:

1 OPTIONAL EXTERNAL EVENT MONITOR/MEMORY

2 OPTIONAL IEEE-488 OR RS-232

Figure 7.2. Analyzer Chassis Assembly Installation Reference (AC/DC Version Only), (Sheet 2 of 3)

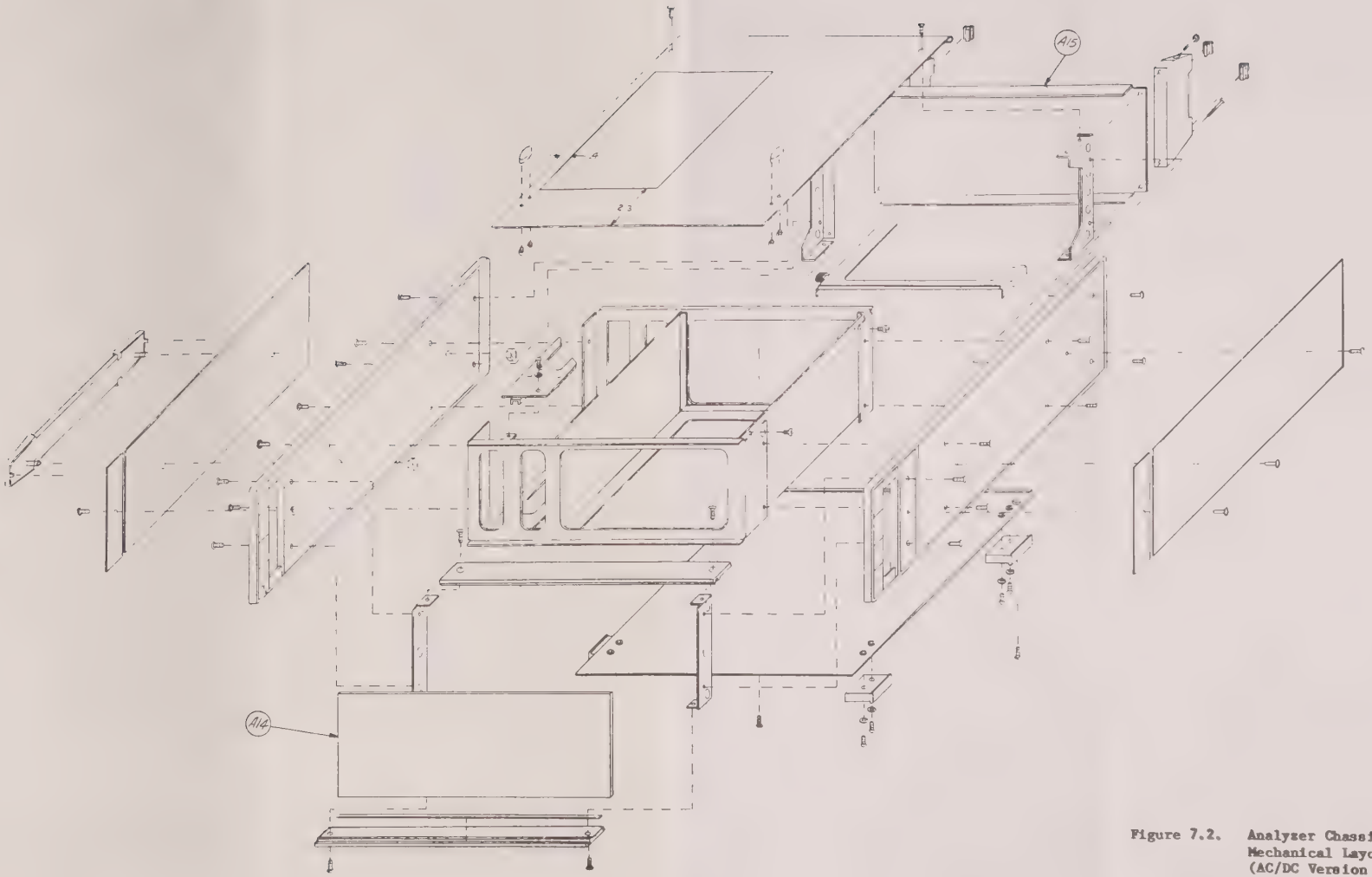
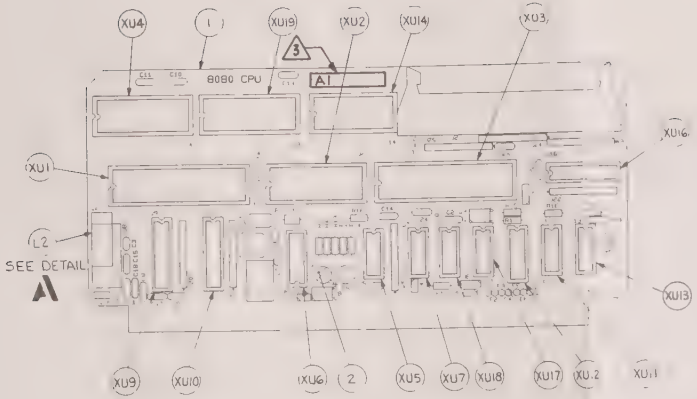
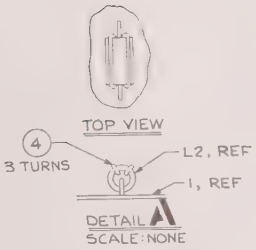


Figure 7.2. Analyzer Chassis Assembly Mechanical Layout (AC/DC Version Only) (Sheet 3 of 3)





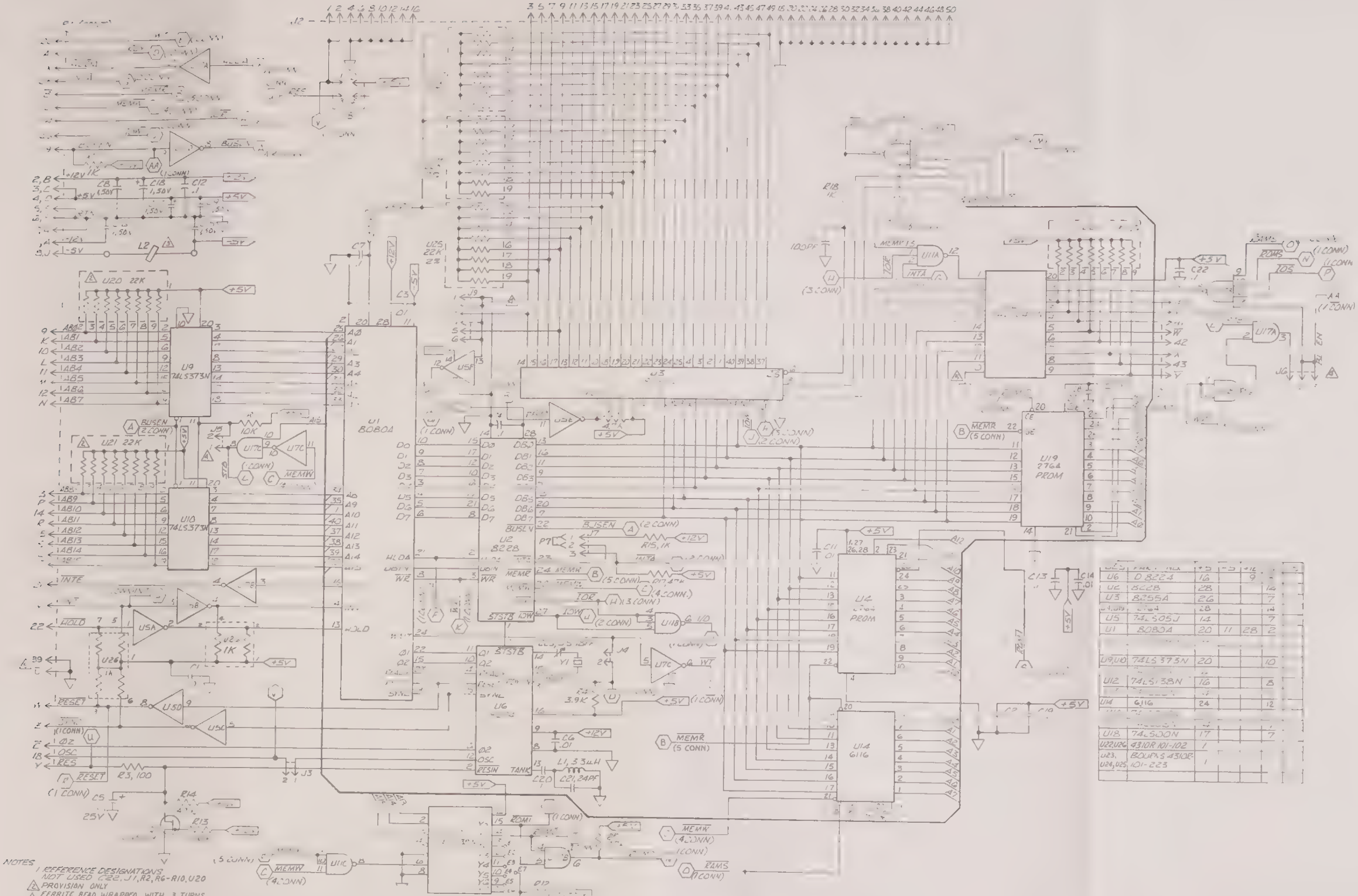
NOTES:
1. REF DES NOT USED: J1, R2, R6-R10, U15, XU8, XU15
2. REF DES NOT INSTALLED: C16, J3-J6, J8, J9, U4, U8, U19, U1, U3

⚠

ASSEMBLY NUMBER	* SERIAL NUMBER	
	FROM	TO
313220	1	46
314130	47	121
315278	122	206
316186	207	

* SERIAL NUMBER IS APPROXIMATE.

Figure 7.3. Analyzer 8080 CPU Assembly (A1), Component Location



NOTES

1 REFERENCE DESIGNATIONS NOT USED C22, J1, R2, R6-R10, U20

2 PROVISION ONLY

3 FERRITE BEAD WRAPPED WITH 3 TURNS OF WIRE ITEM 4.

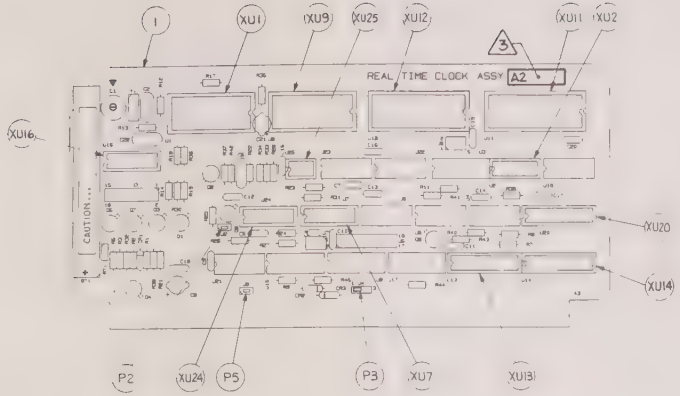
4 CONNECTOR NOT INSTALLED.

5 GROUND U16-10 TO P1-39 & U BY A SHORT PATH

[illegible]	PART NO.	+5	-5	+12	[illegible]
U6	D8224	16		9	
U2	8228	28			14
U3	8255A	26			7
U4,U19	2764	28			14
U5	74LS05J	14			7
U1	8080A	20	11	28	2
[illegible]	[illegible]	[illegible]			
U9,U10	74LS373N	20			10
[illegible]	[illegible]	[illegible]			
U12	74LS138N	16			8
[illegible]	[illegible]	[illegible]			
U14	6116	24			12
[illegible]	[illegible]	[illegible]			
[illegible]	[illegible]	[illegible]			
U18	74LS00N	17			7
U22,U26	4310R 101-102	1			
U23, U24,U25	BOURNS 4310R-101-223	1			

Figure 7.4. Analyzer 8080 CPU Assembly (A1), Schematic

252868B
35G039B



NOTES:

1. THE FOLLOWING ITEMS TO BE INSTALLED AFTER WAVE SOLDER: P2, P3, P5, U1, U2, U7, U9, U13, U14, U16, U20, U24, U25.

2. REF DES NOT USED: C3, J1, R4, R10, R15, R16, R20, R25, U10, U19, XU3-XU6, XU8, XU10, XU15, XU17-XU19, XU21-XU23.

⚠

ASSEMBLY NUMBER	* SERIAL NUMBER	
	FROM	TO
313103	1	228
316190	229	

* SERIAL NUMBER IS APPROXIMATE

Figure 7.5. Analyzer Real-Time Clock Assembly (A2), Component Location

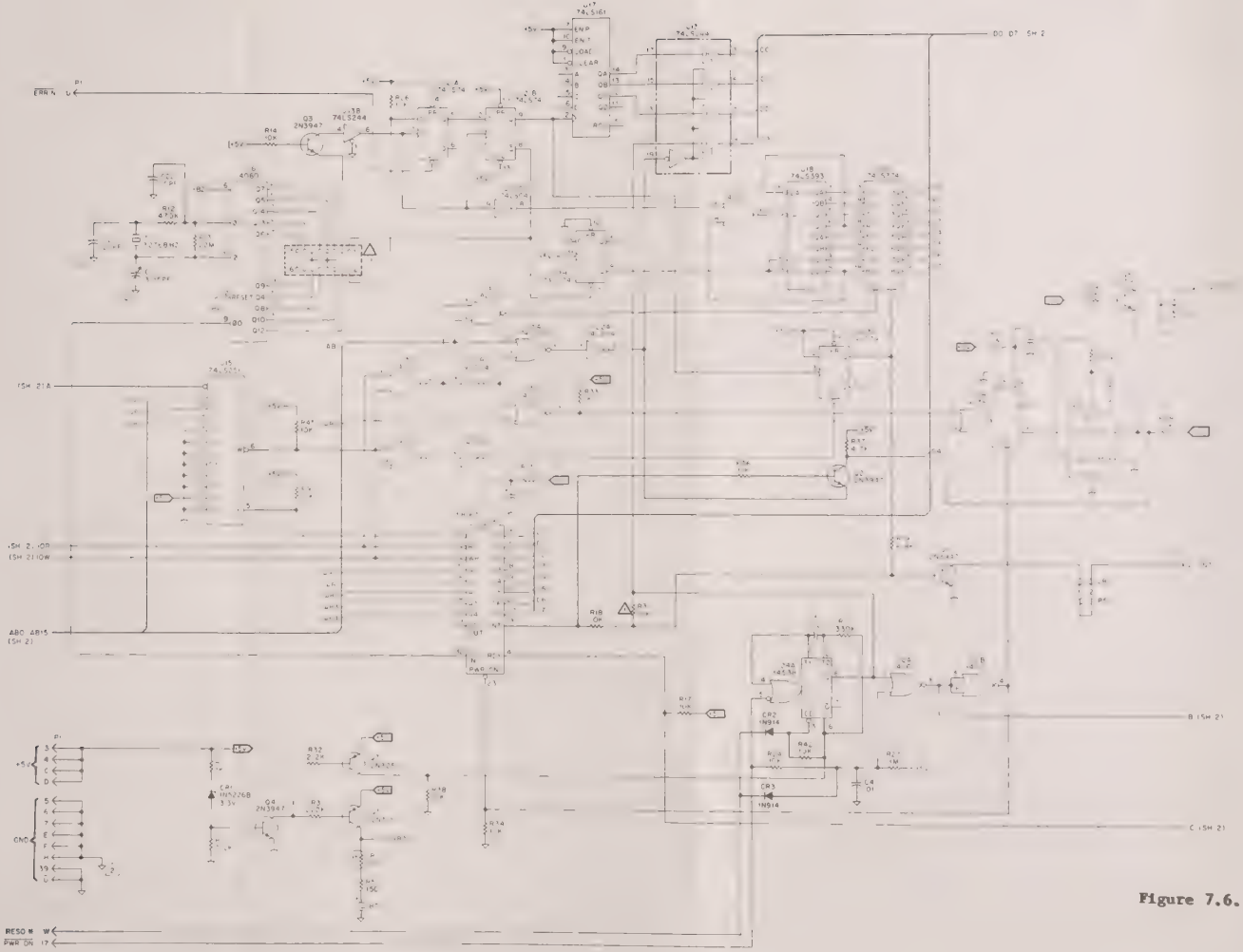
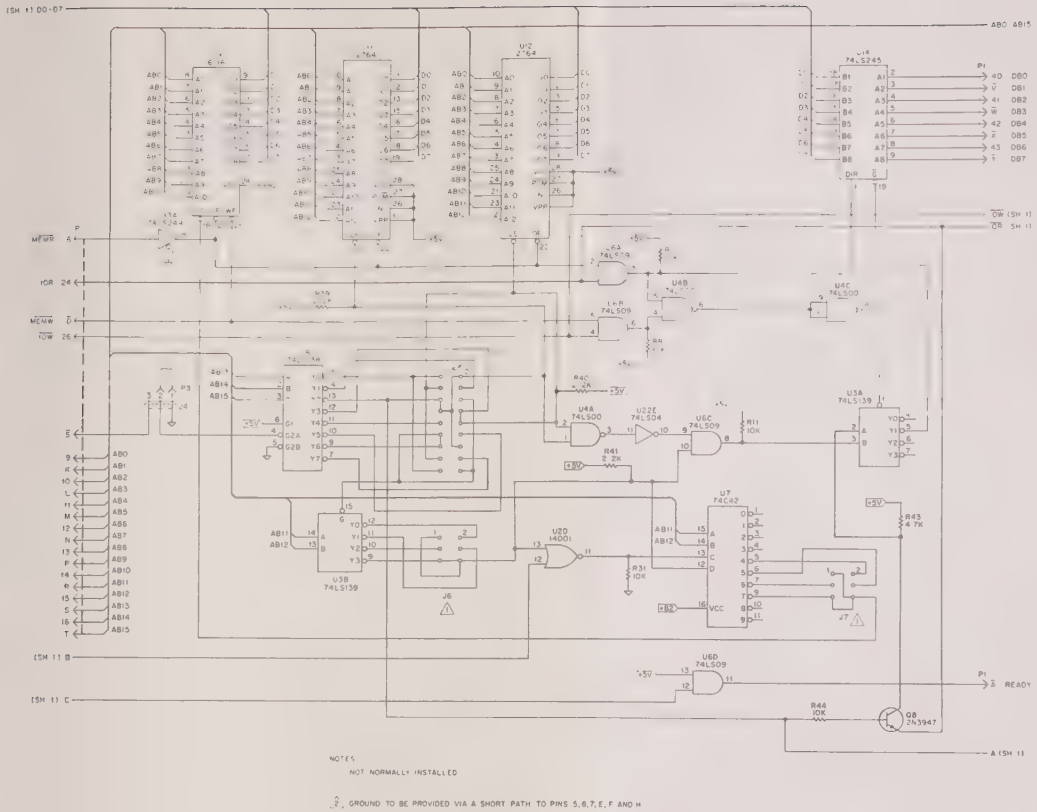


Figure 7.6. Analyzer Real-Time Clock Assembly (A2), Schematic (Sheet 1 of 2)



IC	TYPE	+5v	GND
U1	5865	-	12
U2	14001	14	7
U3	74LS139	16	8
U4	74LS30	14	7
U5	74LS02	14	7
U6	74LS09	14	7
U7	74C42	-	8
U8	74LS138	16	8
U9	6116	-	12
U11 12	2764	28	14
U13	74LS244	20	10
U14	74LS245	20	10
U15	74LS251	16	8
U16	4060	-	8
U17	74LS161	16	8
U18	74LS393	14	7
U20	74LS374	20	10
U21 23	74LS74	14	-
U22	74LS04	14	7
U24	14538	-	8
U25	3905	5	4

Figure 7.6. Analyzer Real-Time Clock Assembly (A2), Schematic (Sheet 2 of 2)

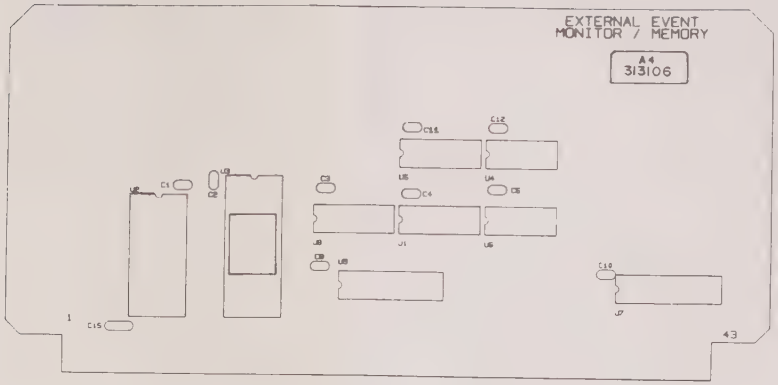
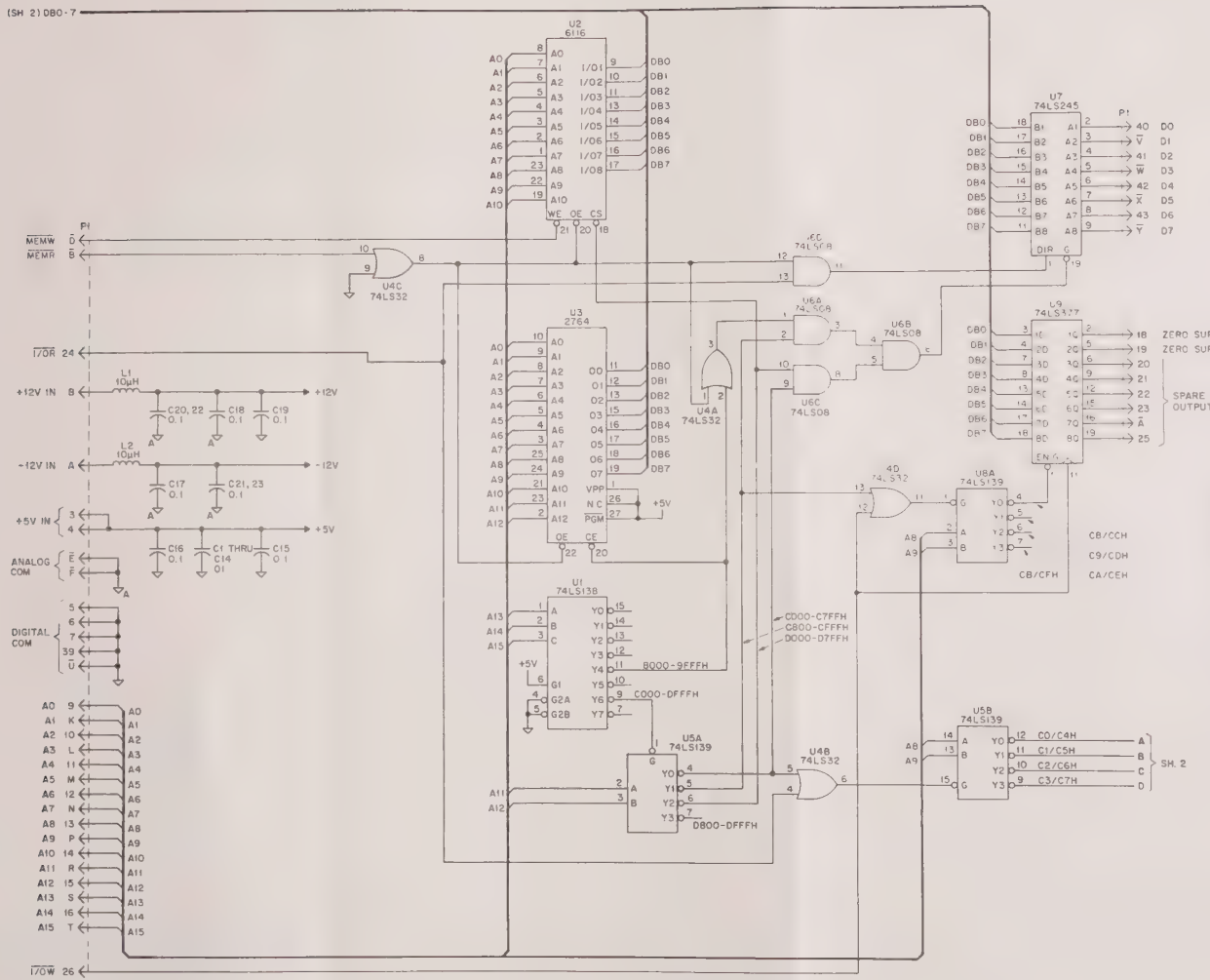


Figure 7.7. Analyzer Memory Assembly (A4), Component Location

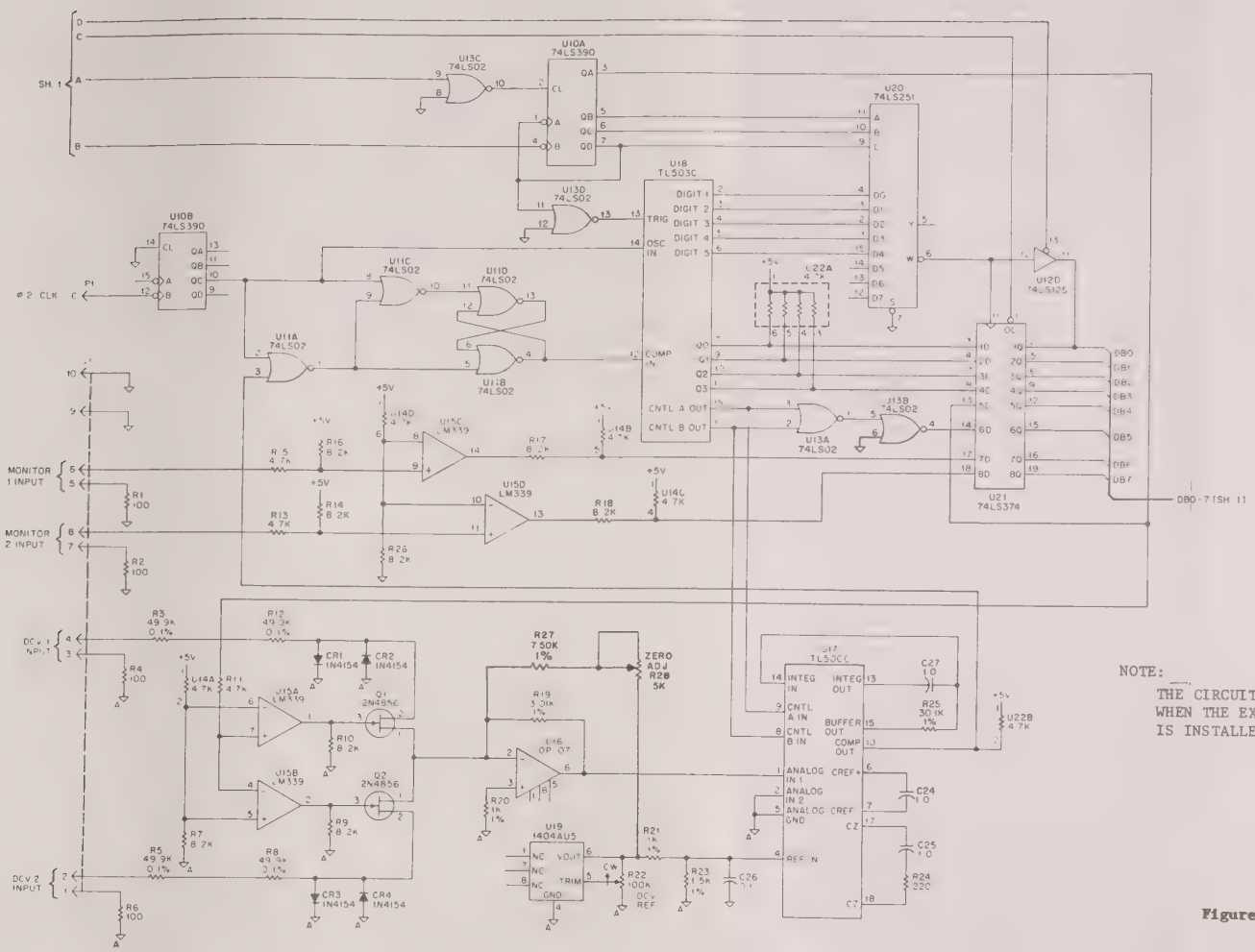


REFERENCE DESIGNATION	TYPE NUMBER	PIN NUMBER			
		+5V	+12V	-12V	GND
U1	74LS138	16	-	-	8
U2	6116	24	-	-	12
U3	2764	28	-	-	14
U4	74LS32	14	-	-	7
U5, 8	74LS139	16	-	-	8
U6	74LS08	14	-	-	7
U7	74LS245	20	-	-	10
U9	74LS377	20	-	-	10
U10	74LS390	16	-	-	8
U11, 13	74LS02	14	-	-	7
U12	74LS125	14	-	-	7
U15	LM339	3	-	12	-
U16	OP-07	-	7	4	-
U17	TL500C	-	16	12	11
U18	TL503C	16	-	-	8
U19	1405AU5	-	2	-	-
U20	74LS251	16	-	-	8
U21	74LS374	20	-	-	10

NOTE.

THE CIRCUITRY ON SHEET 2 IS USED ONLY WHEN THE EXTERNAL EVENT MONITOR OPTION (304210) IS INSTALLED.

Figure 7.8. Analyzer Memory Assembly (A4), Schematic (Sheet 1 of 2)



NOTE:

THE CIRCUITRY ON THIS SHEET IS USED ONLY WHEN THE EXTERNAL EVENT MONITOR OPTION (304210) IS INSTALLED.

Figure 7.8. Analyzer Memory Assembly (A4), Schematic (Sheet 2 of 2)

304146A
35G039A

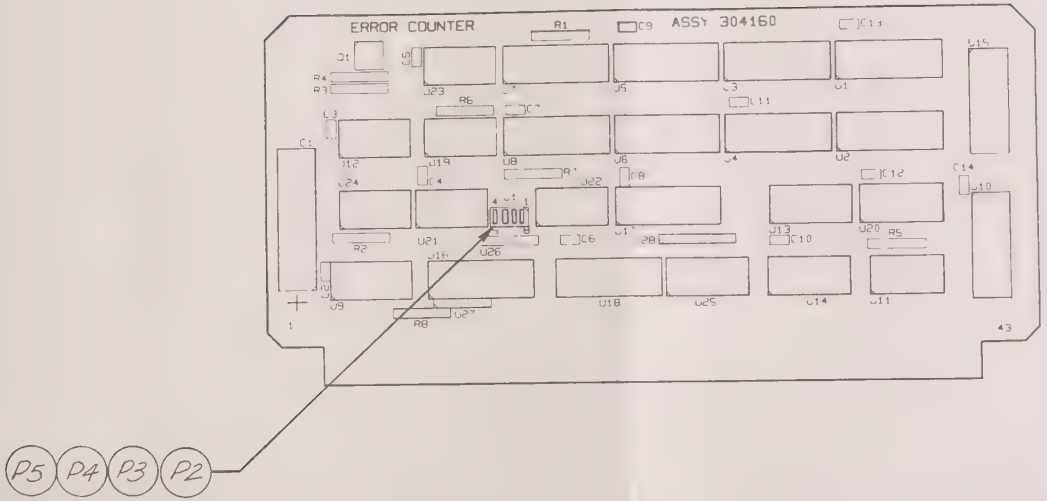


Figure 7.9. Analyzer Error Counter Assembly (A5), Component Location

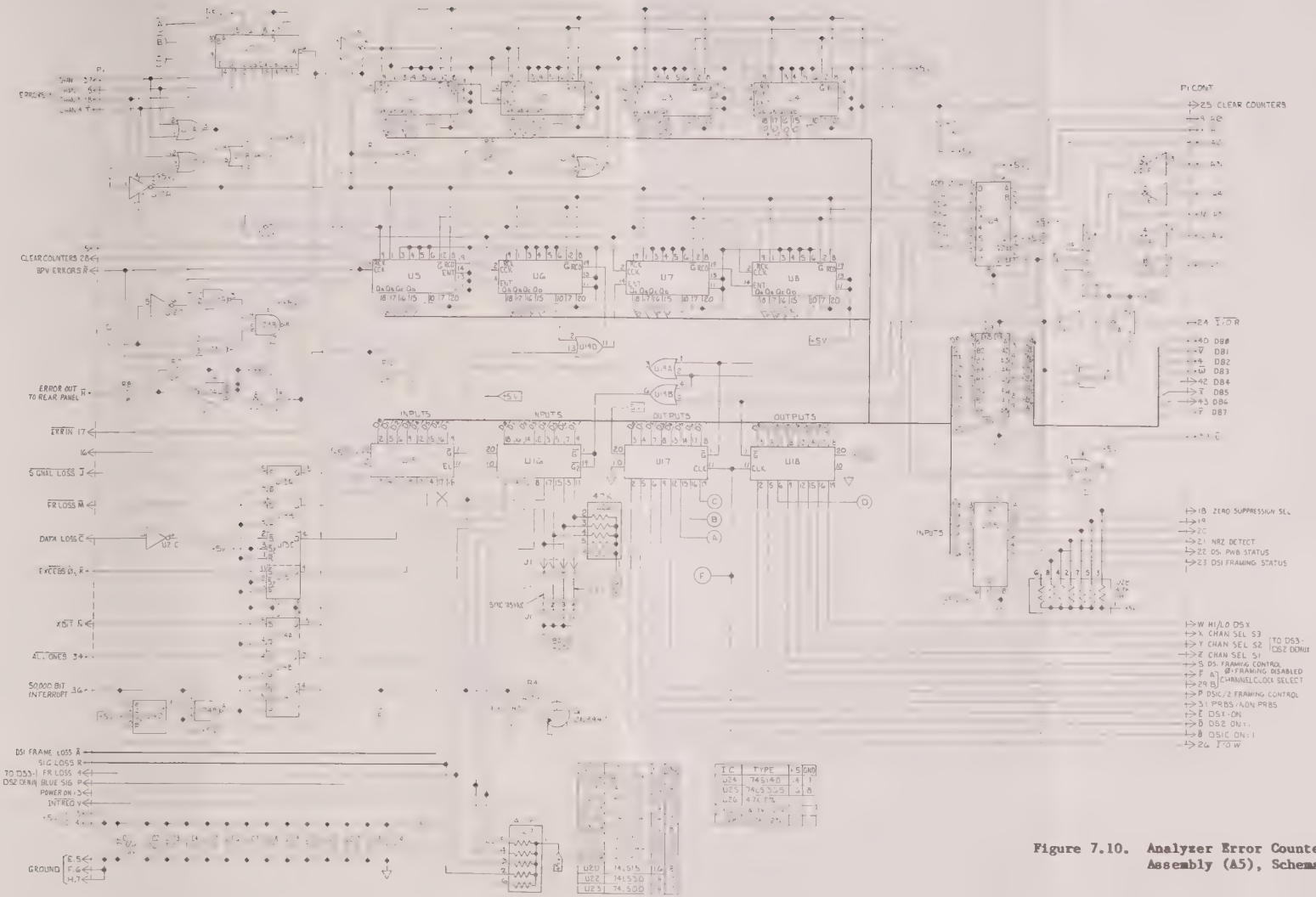
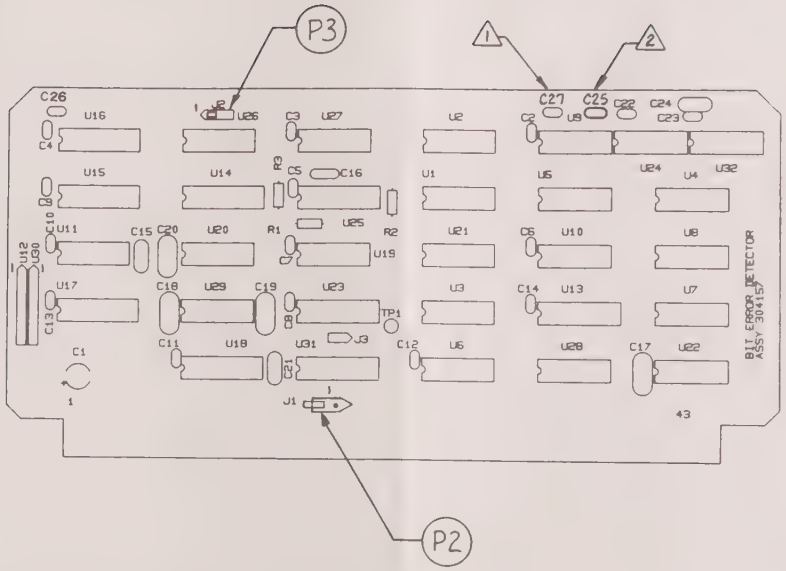


Figure 7.10. Analyzer Error Counter Assembly (A5), Schematic

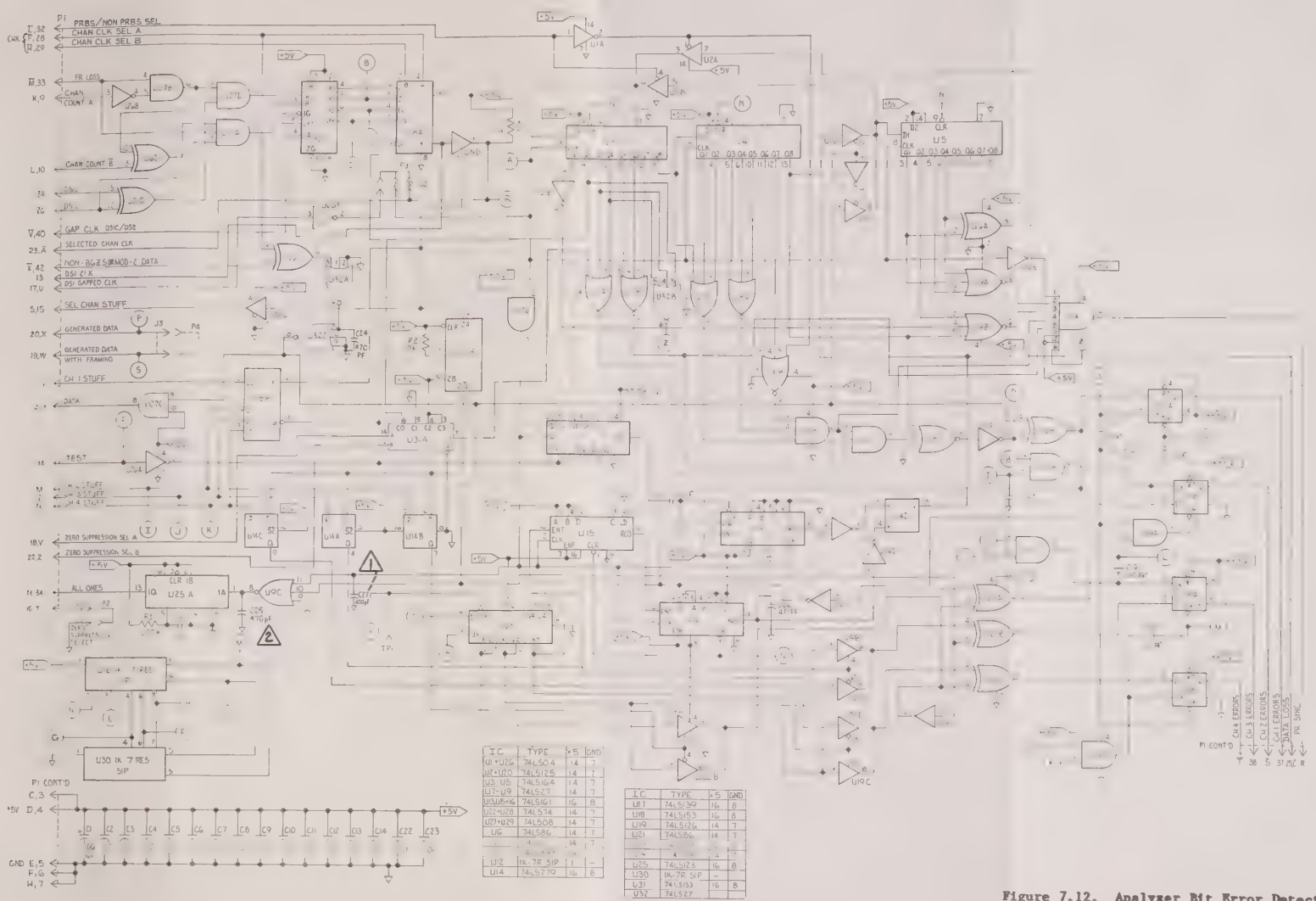
304158A
35G039B



1 C27 APPLIES TO SERIAL NUMBER 128 AND ABOVE (APPROXIMATELY), AND C25 (NOT SHOWN) APPLIES TO SERIAL NUMBER 127 AND BELOW (APPROXIMATELY).

2 C25 VALUE MAY BE .001 MF ON SERIAL NUMBER 127 AND BELOW (APPROXIMATELY).

Figure 7.11. Analyzer Bit Error Detector Assembly (A6), Component Location



IC	TYPE	+5	GND
U1-U26	74LS04	14	7
U2-U20	74LS125	14	7
U3-U5	74LS164	14	7
U17-U9	74LS27	14	7
U3U5+16	74LS161	16	8
U22-U28	74LS74	14	7
U27-U29	74LS08	14	7
U6	74LS86	14	7
U12	1K-7R SIP	1	-
U14	74LS279	16	8

IC	TYPE	+5	GND
U17	74LS139	16	8
U18	74LS153	16	8
U19	74LS126	14	7
U21	74LS86	14	7
U25	74LS123	16	8
U30	1K-7R SIP	-	
U31	74LS153	16	8
U32	74LS27		

1 APPLIES TO SERIAL NUMBER 128 AND ABOVE (APPROXIMATELY).

2 C25 VALUE MAY BE .001 MF ON SERIAL NUMBER 127 AND BELOW (APPROXIMATELY).

Figure 7.12. Analyzer Bit Error Detector Assembly (A6), Schematic

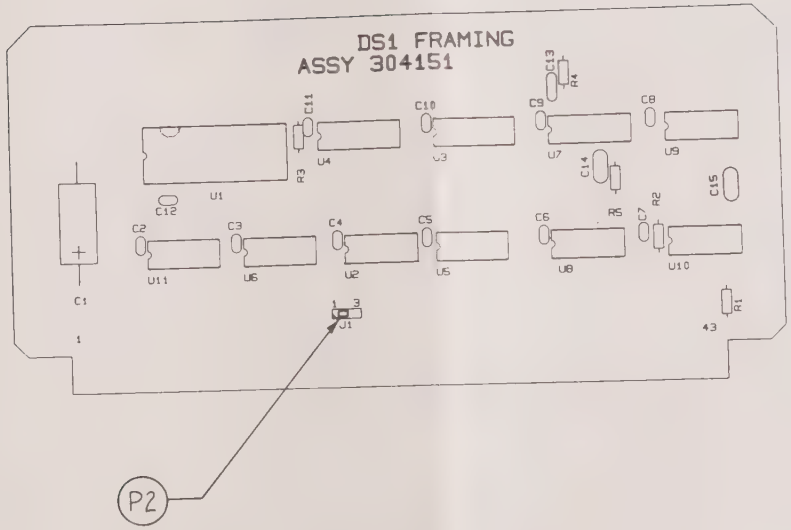
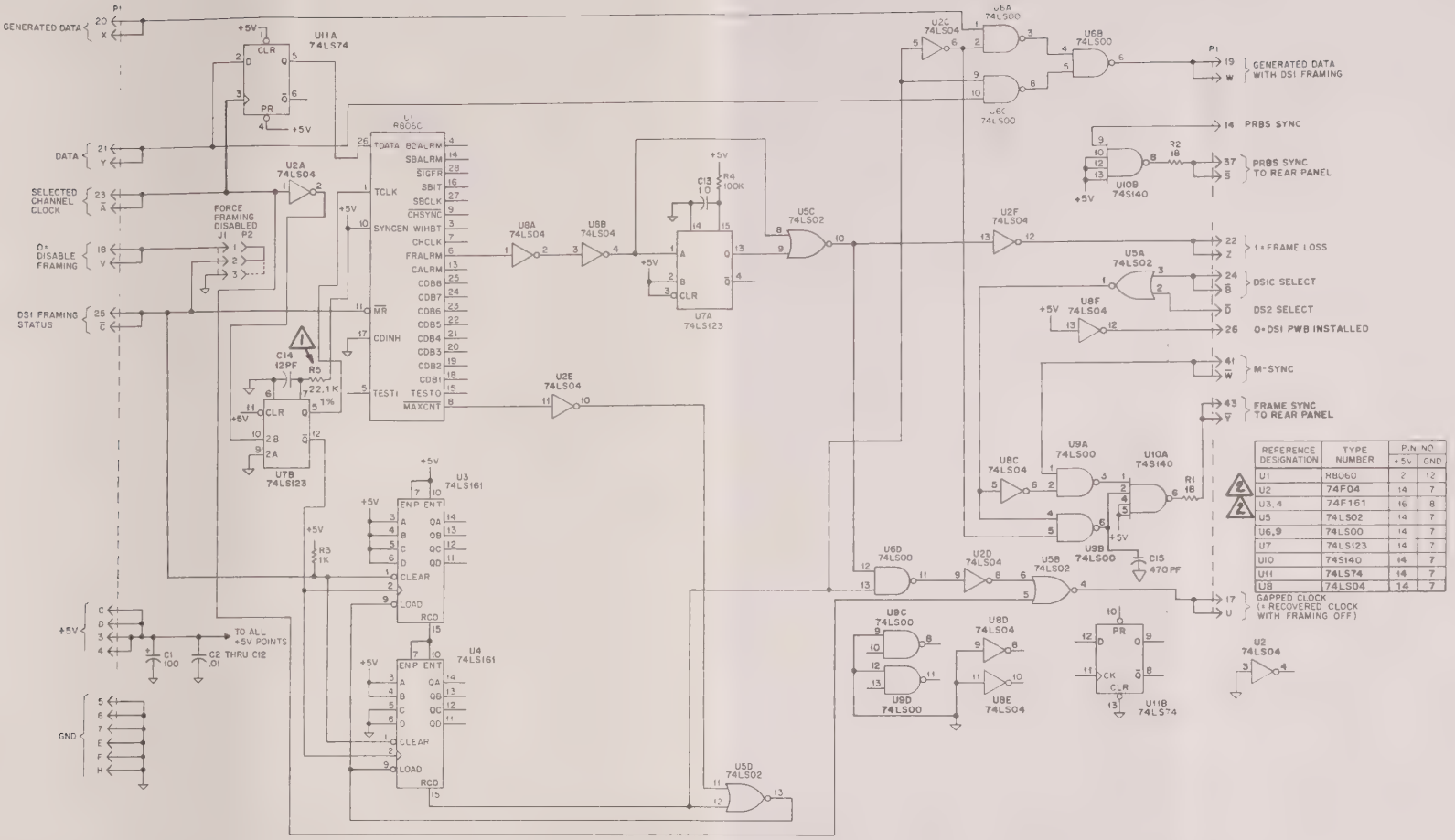


Figure 7.13. Analyzer DS1 Framing Assembly (A7), Component Location



1. R5 VALUE MAY BE 17.8K OHMS ON SERIAL NUMBER 189 THROUGH 197 (APPROXIMATELY).
2. U2 MAY BE 74LS04 AND U3 & U4 MAY BE 74LS161 ON SERIAL NUMBER 197 AND BELOW (APPROXIMATELY).

Figure 7.14. Analyzer DS1 Framing Assembly (A7), Schematic

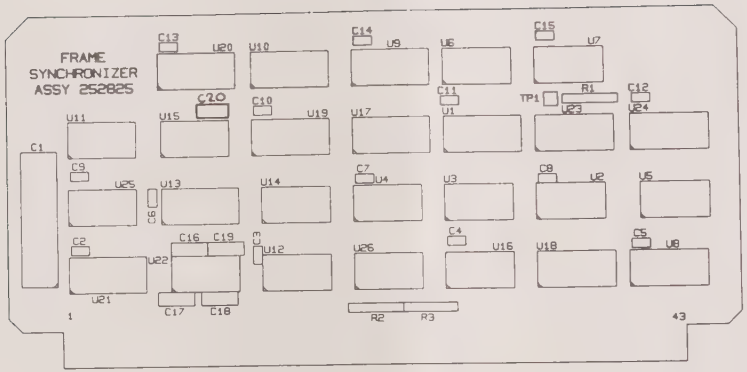
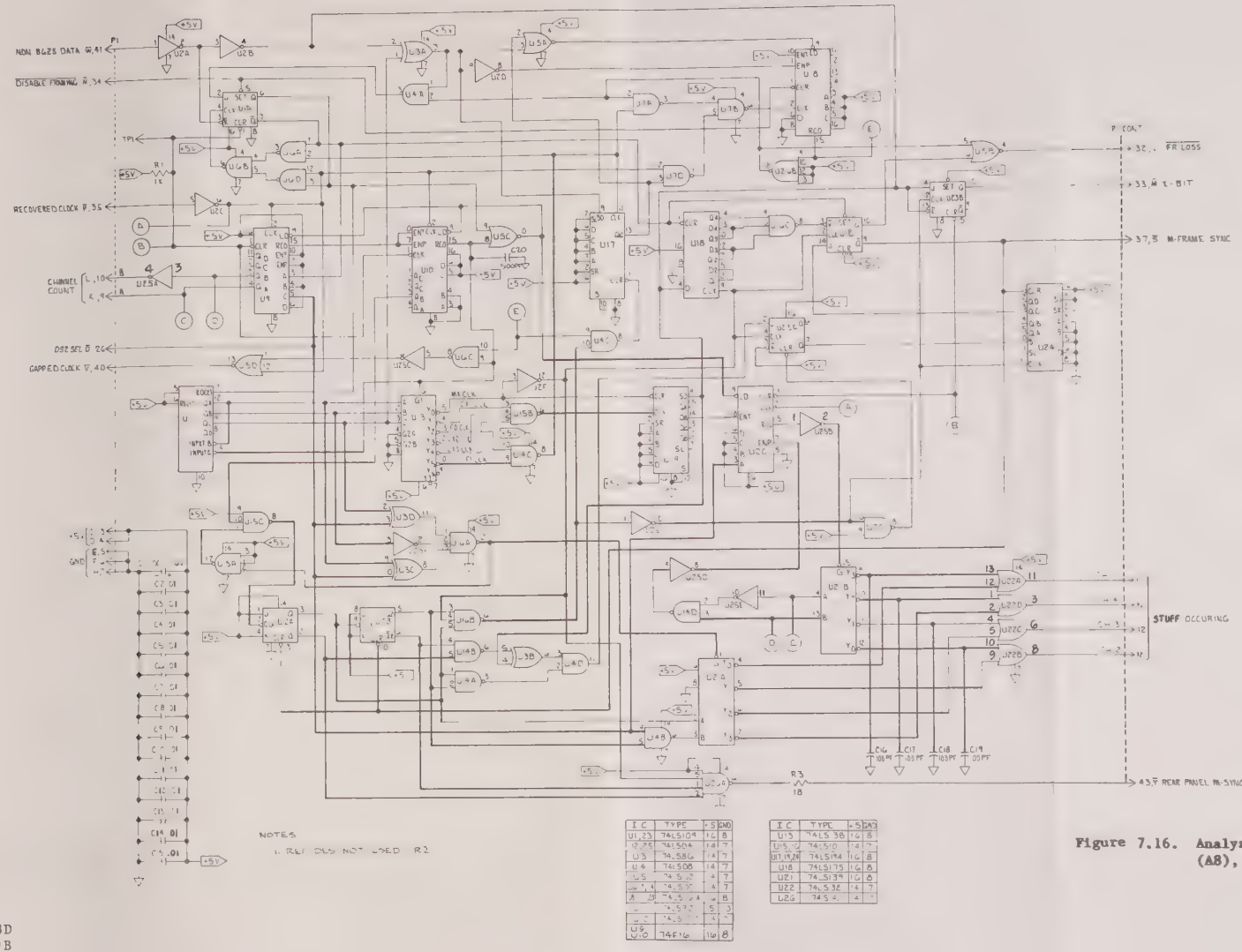


Figure 7.15. Analyzer Frame Sync. Assembly (A8), Component Location



I C	TYPE	+5	GND
U1, 23	74LS109	16	8
17, 35	74LS04	14	7
U3	74LS86	14	7
U4	74LS06	14	7
U5	74LS2[illegible]	4	7
U6, 7, 4	74LS32	4	7
A, 28	74LS[illegible]	4	8
[illegible]	74LS[illegible]	5	3
[illegible]	[illegible]	4	7
U9	[illegible]	[illegible]	[illegible]
U10	74F16	16	8

I C	TYPE	+5	GND
U13	74LS 38	16	8
U15, 22	74LS10	14	7
U11, 19, 24	74LS14	16	8
U18	74LS175	16	8
U21	74LS139	16	8
U22	74LS32	14	7
U26	74LS 4[illegible]	4	[illegible]

Figure 7.16. Analyzer Frame Sync. Assembly (A8), Schematic

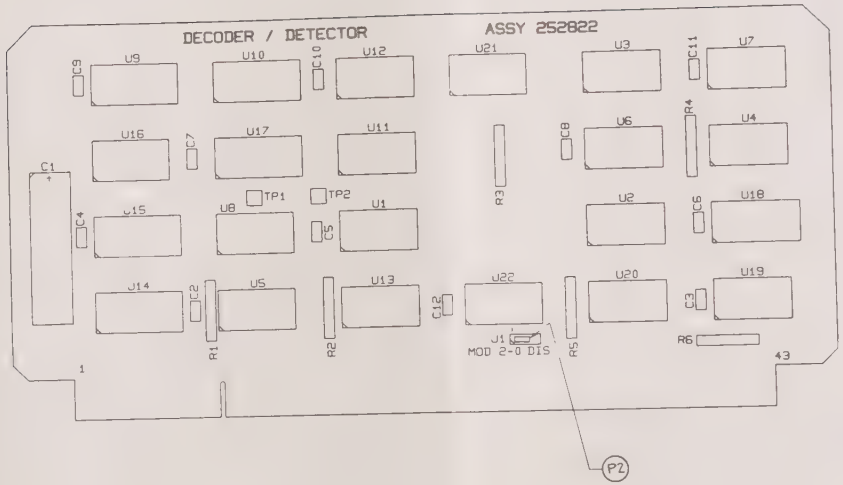


Figure 7.17. Analyzer Decoder/Detector Assembly (A9), Component Location

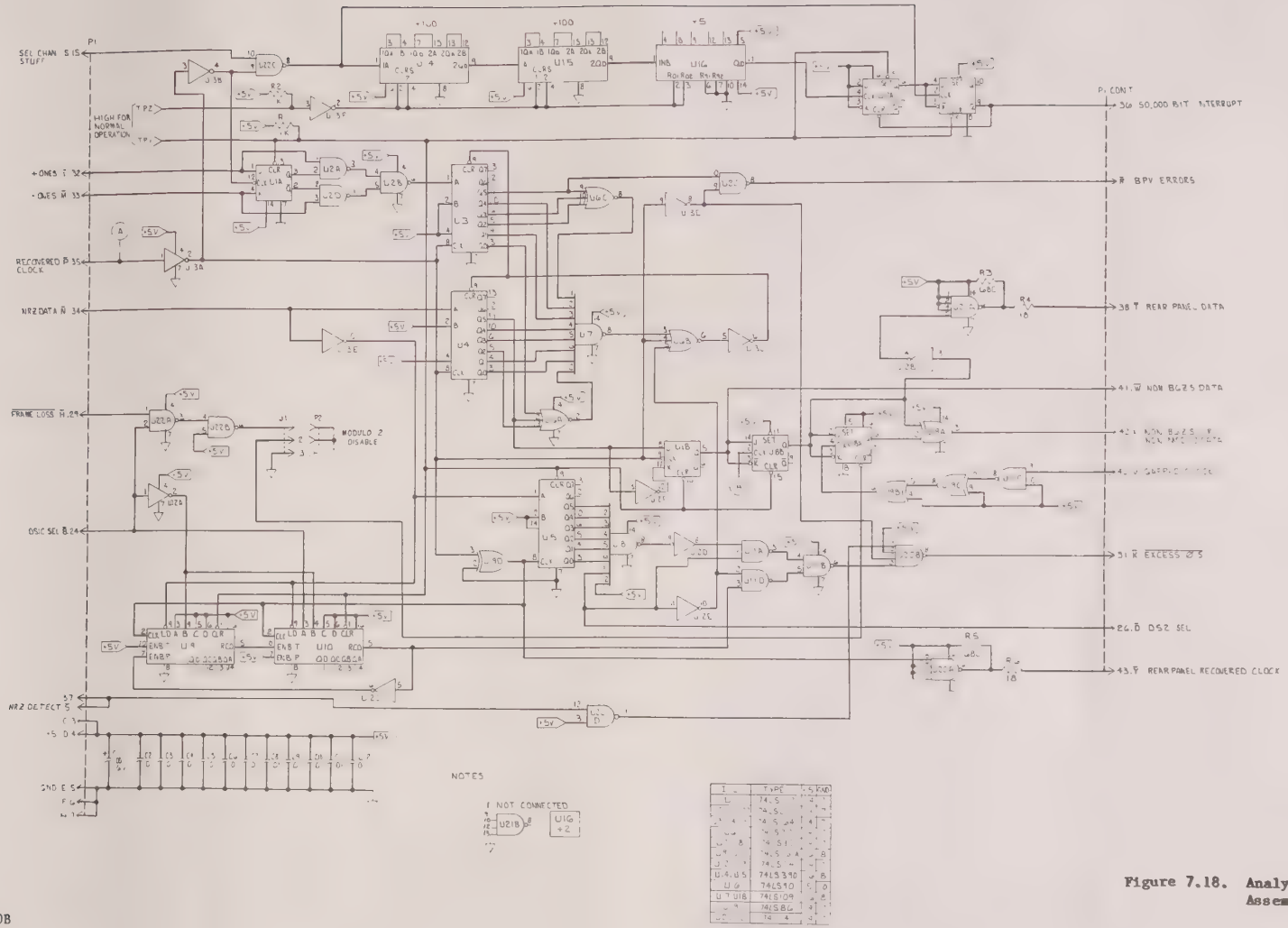


Figure 7.18. Analyzer Decoder/Detector Assembly (A9), Schematic

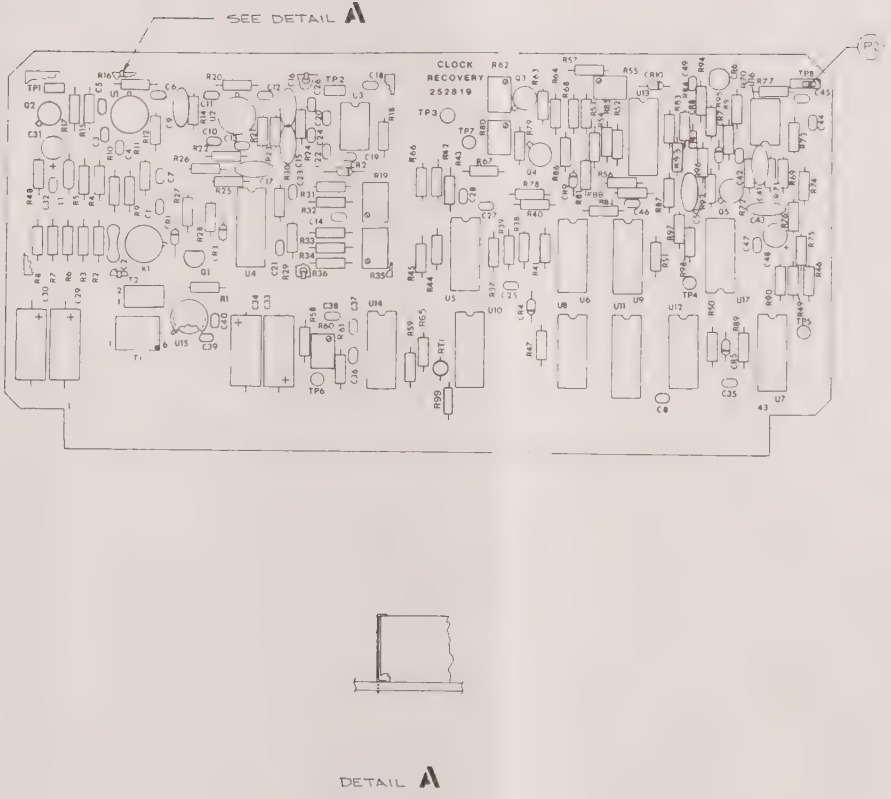
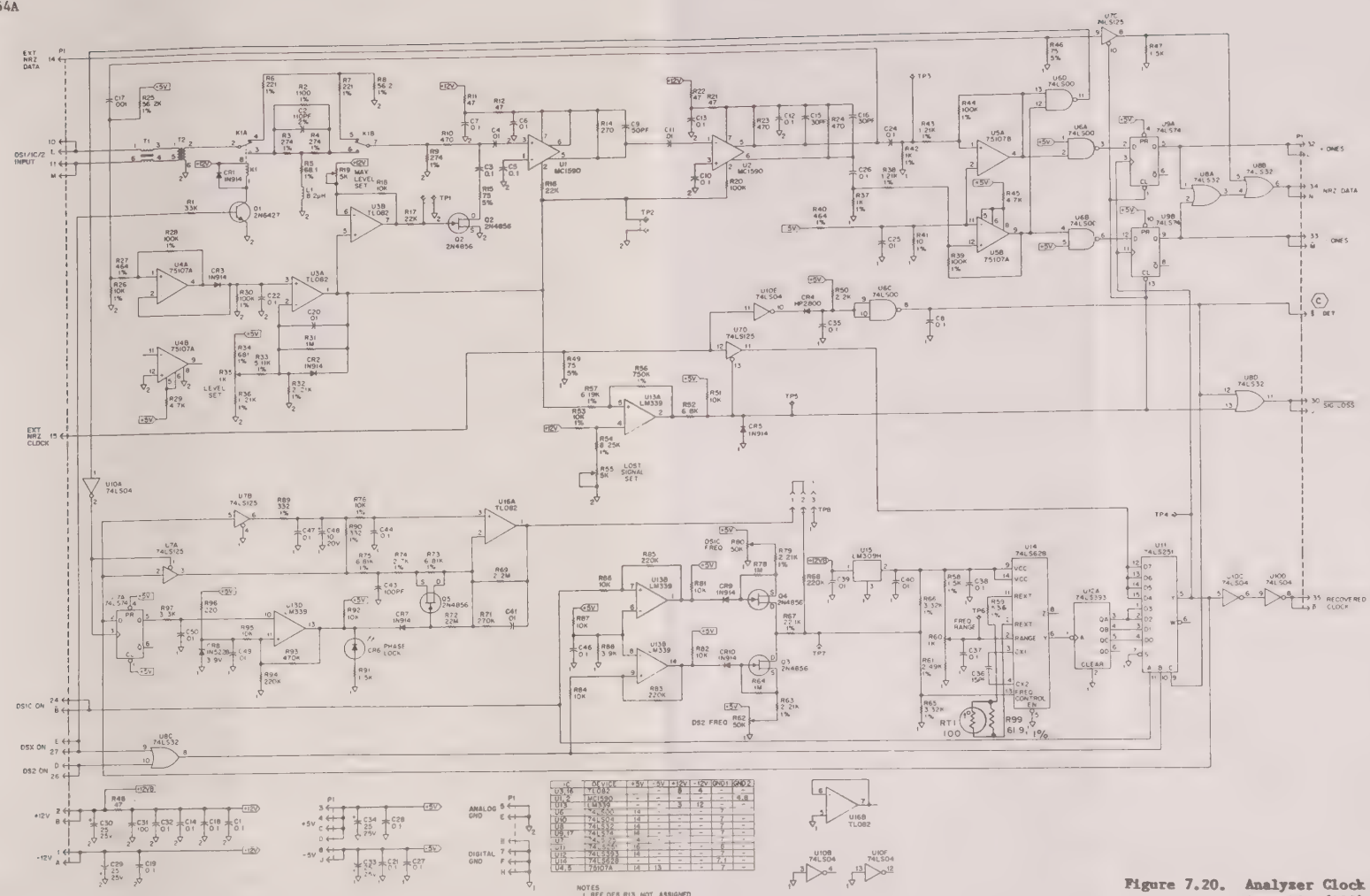


Figure 7.19. Analyzer Clock Recovery Assembly (A10), Component Location



IC	DEVICE	+5V	-5V	+12V	-12V	GND1	GND2
U3,16	TL082	-	-	8	4	-	-
U1,2	MC1590	-	-	-	-	4,8	-
U13	LM339	-	-	3	12	-	-
U6	74LS00	14	-	-	-	7	-
U10	74LS04	14	-	-	-	7	-
U8	74LS32	14	-	-	-	7	-
U9,17	74LS74	14	-	-	-	7	-
U7	74LS125	4	-	-	-	7	-
U11	74LS251	16	-	-	-	8	-
U12	74LS393	14	-	-	-	7,1	-
U14	74LS629	14	-	-	-	7	-
U4,5	75107A	14	13	-	-	7	-

NOTES
1 REF DES R13 NOT ASSIGNED

Figure 7.20. Analyzer Clock Recovery Assembly (A10), Schematic

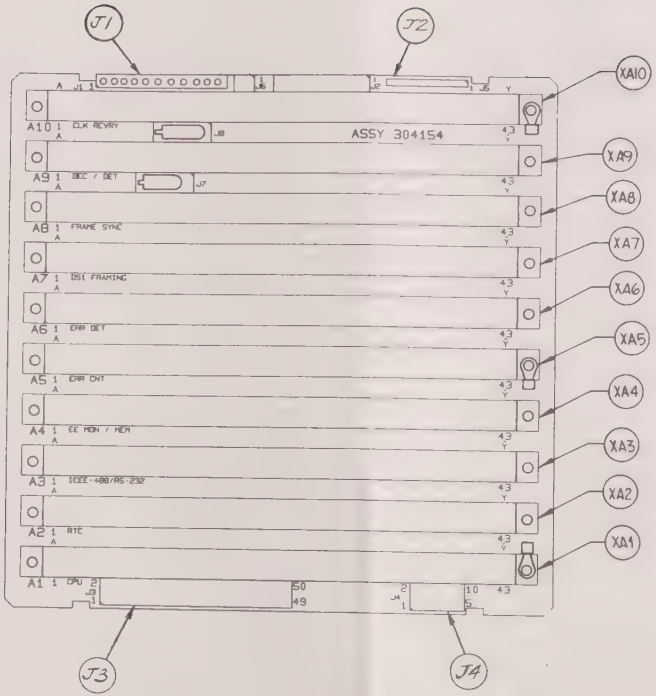


Figure 7.21. Analyzer Motherboard Assembly (A11), Component Location

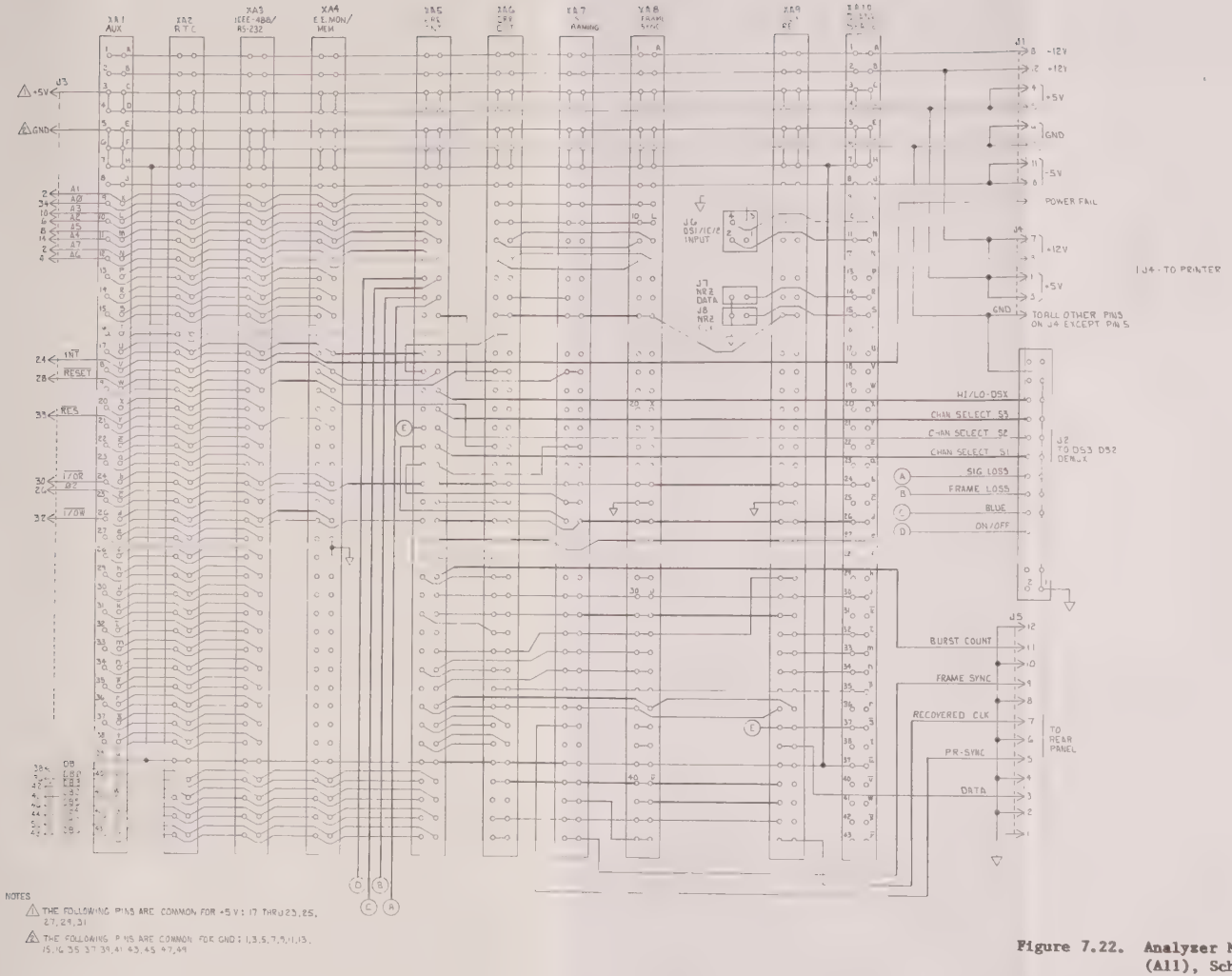


Figure 7.22. Analyzer Motherboard Assembly (A11), Schematic

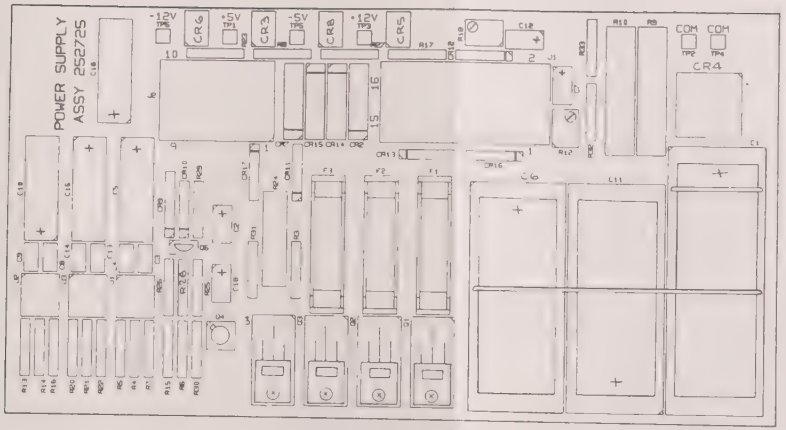


Figure 7.23. Analyzer Power Supply Assembly (A12) (AC Version Only), Component Location

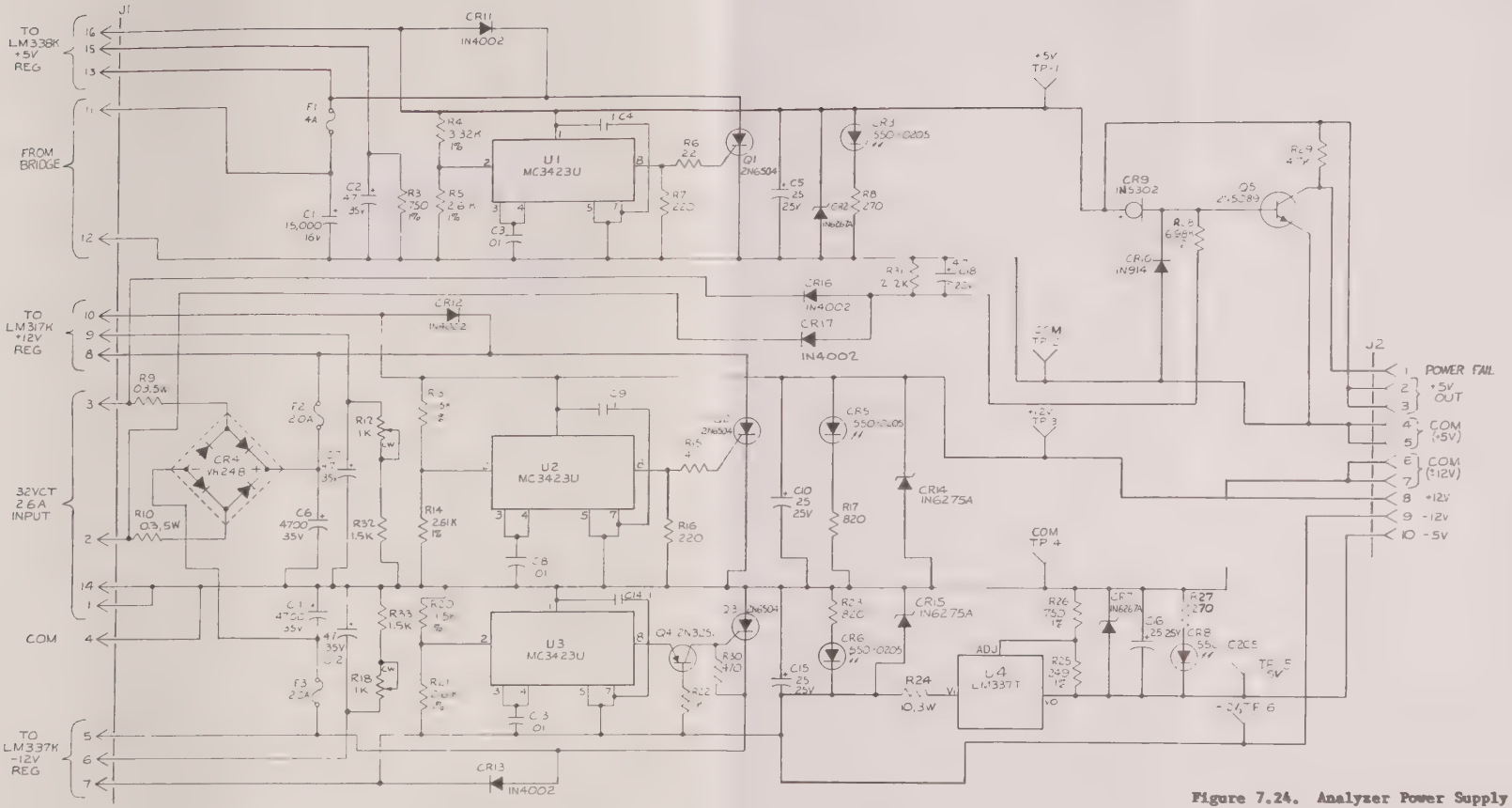


Figure 7.24. Analyzer Power Supply Assembly (A12) (AC Version Only), Schematic

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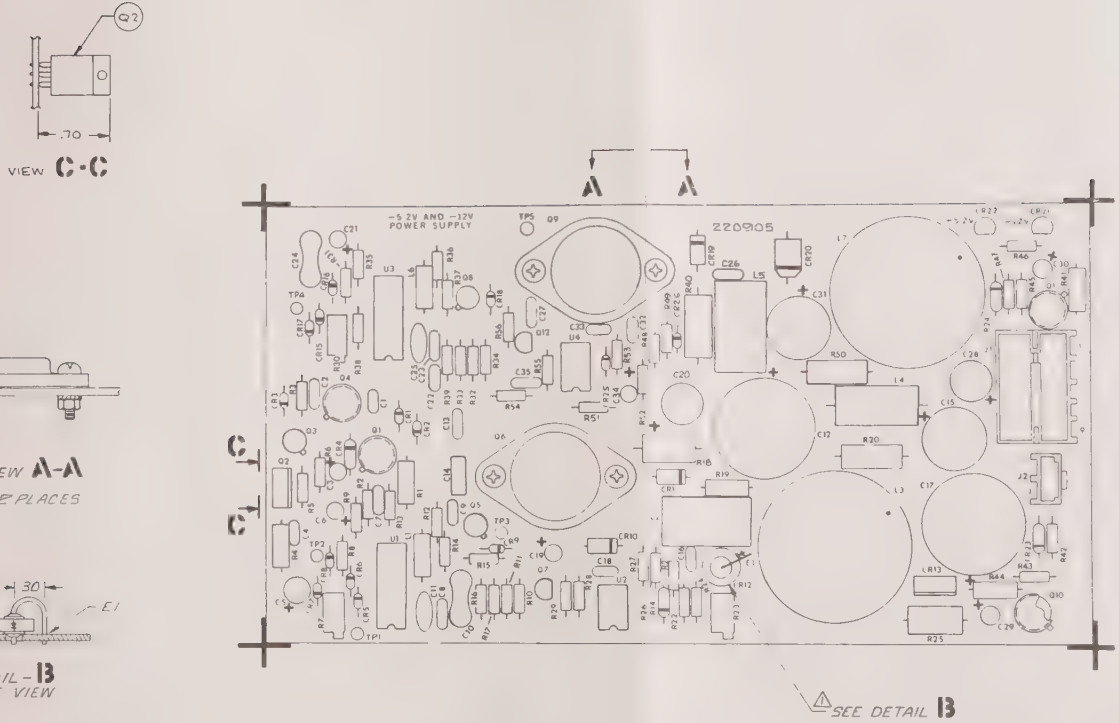


Figure 7.25. Analyzer -5.2V/-12V Power Supply Assembly (A12) (AC/DC Version Only), Component Location

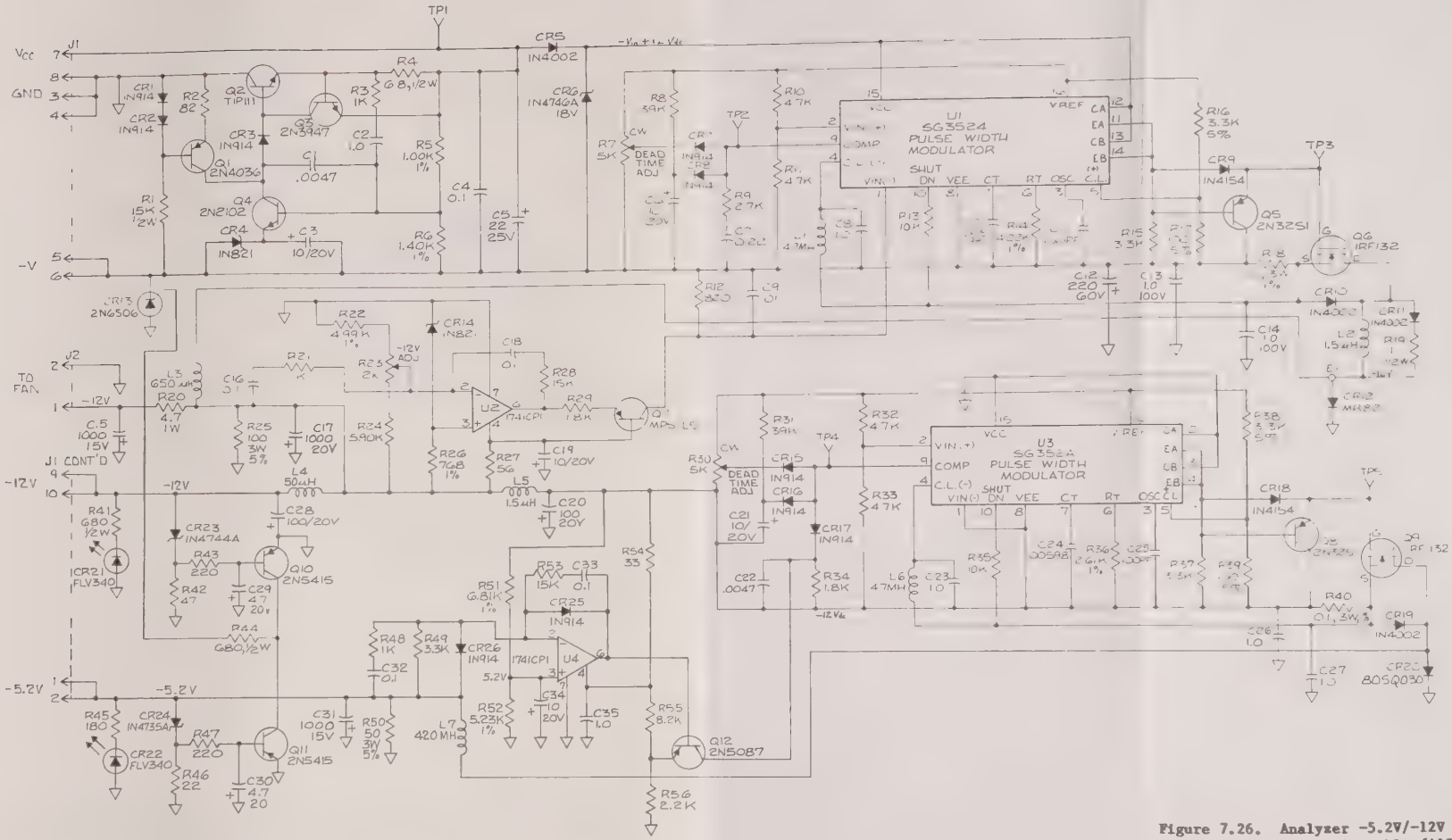
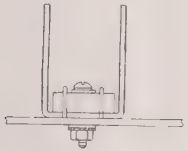


Figure 7.26. Analyzer -5.2V/-12V Power Supply Assembly (A12) (AC/DC Version Only), Schematic

220903B

35G039Z

VIEW A-A
3 PLACES



DETAIL B

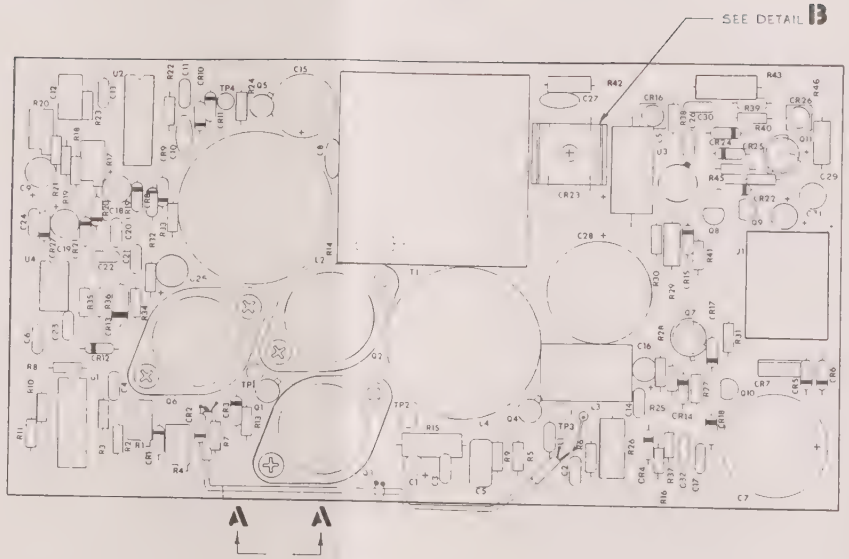
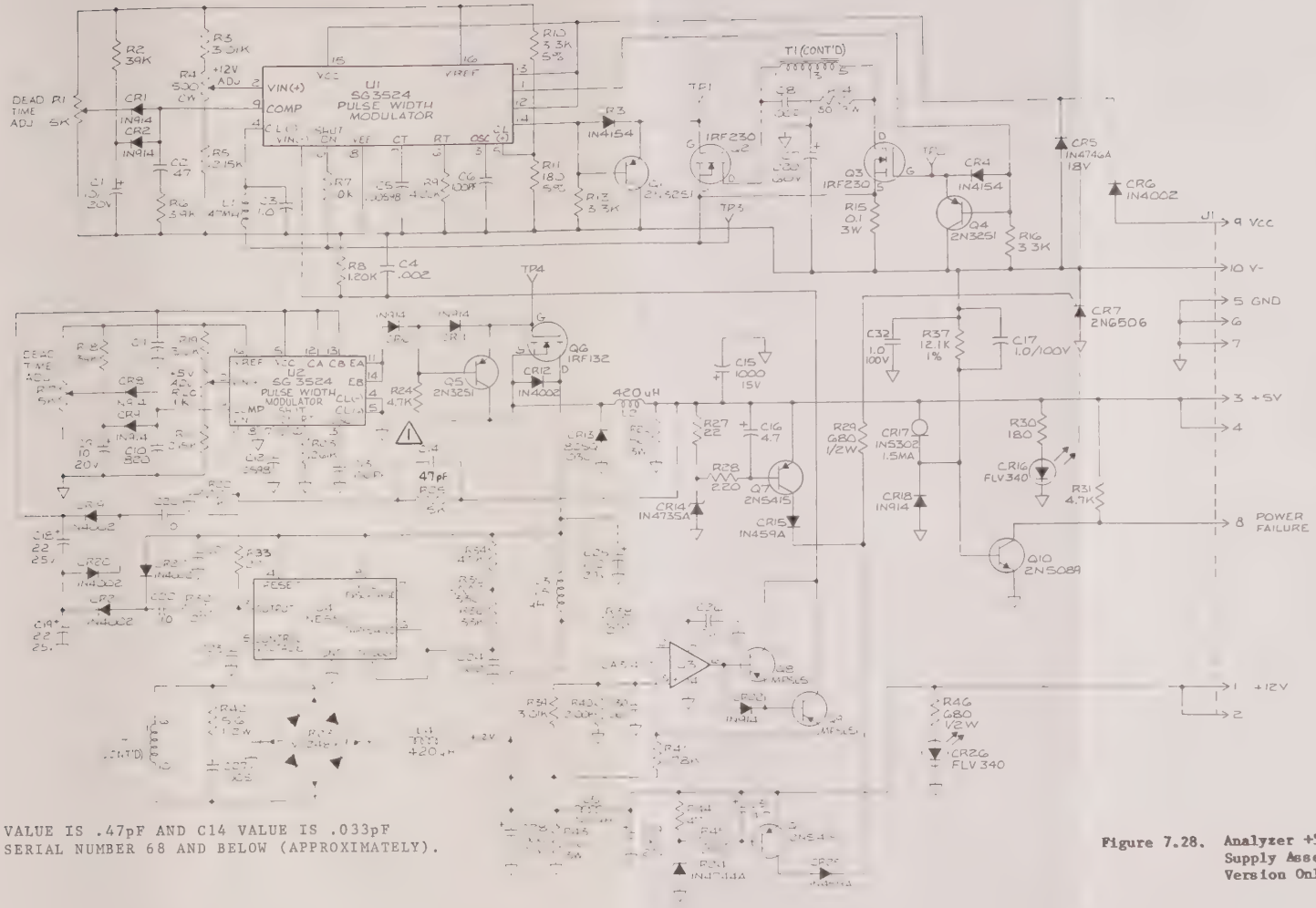


Figure 7.27. Analyzer +5V/+12V Power Supply Assembly (A13) (AC/DC Version Only), Component Location



⚠ C2 VALUE IS .47pF AND C14 VALUE IS .033pF ON SERIAL NUMBER 68 AND BELOW (APPROXIMATELY).

Figure 7.28. Analyzer +5V/+12V Power Supply Assembly (A13) (AC/DC Version Only), Schematic

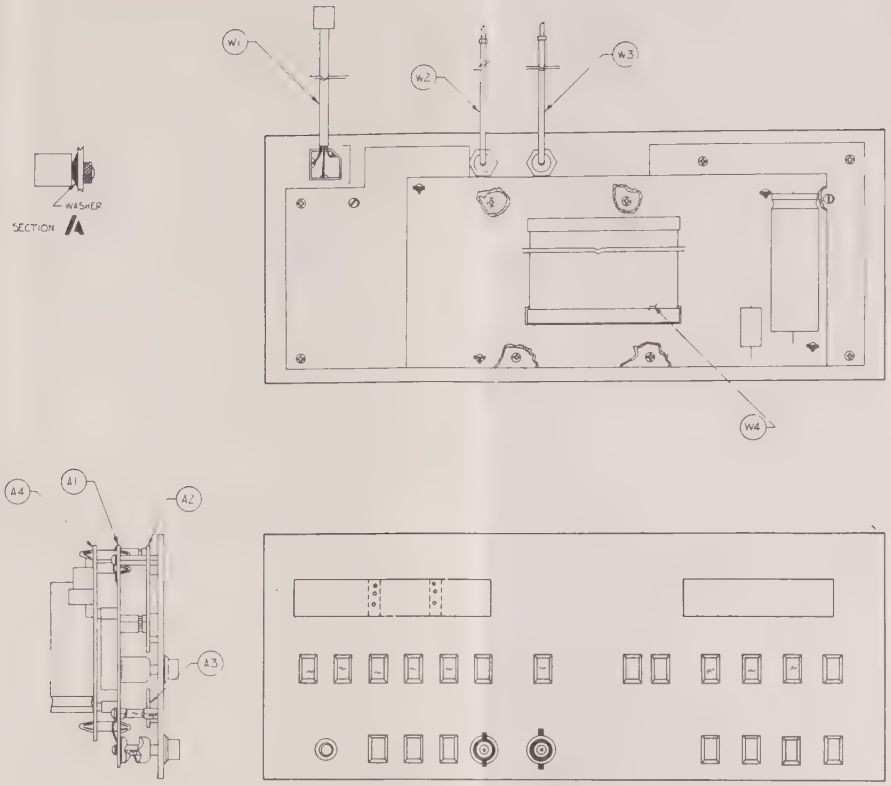


Figure 7.29. Analyzer Front Panel Assembly (A14), Cables and Component Location

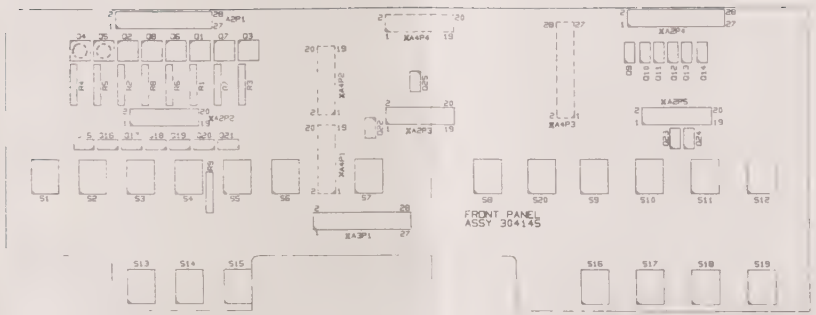


Figure 7.30. Analyzer Front Panel Assembly (A14A1), Component Location

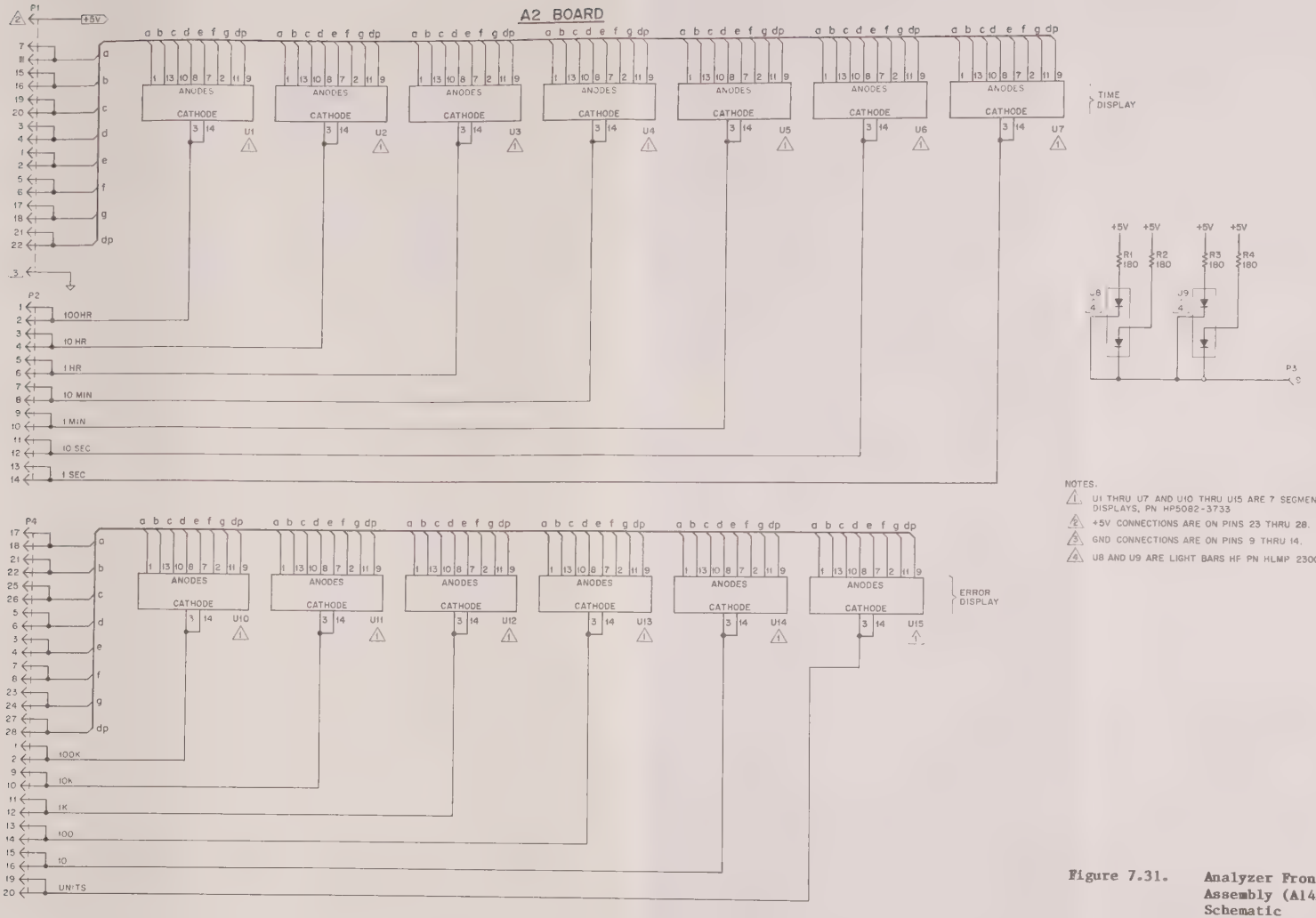


Figure 7.31. **Analyzer Front Panel Assembly (A14A1), Schematic (Sheet 1 of 3)**

304143
35G039B

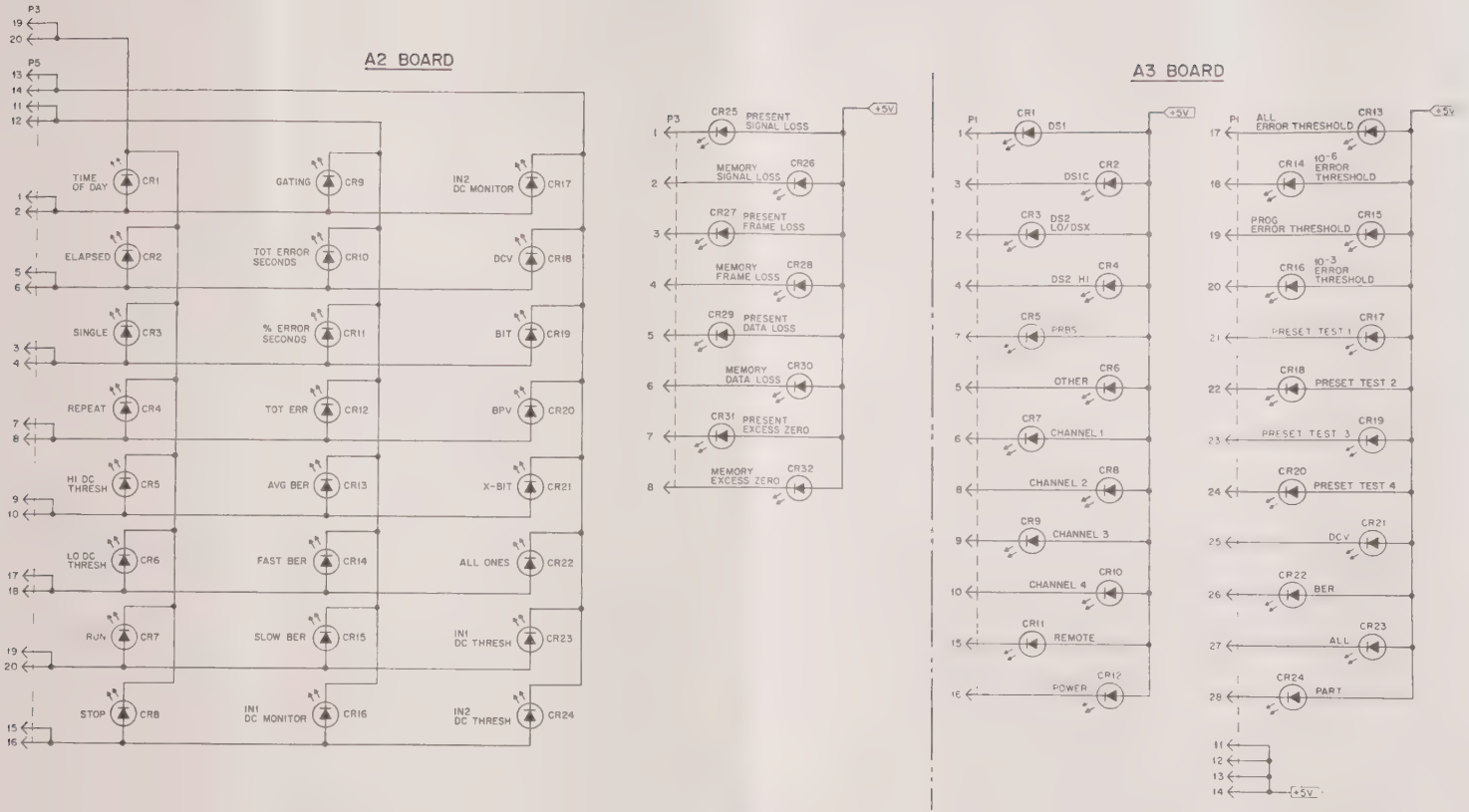


Figure 7.31. Analyzer Front Panel Assembly (A14A1), Schematic (Sheet 2 of 3)

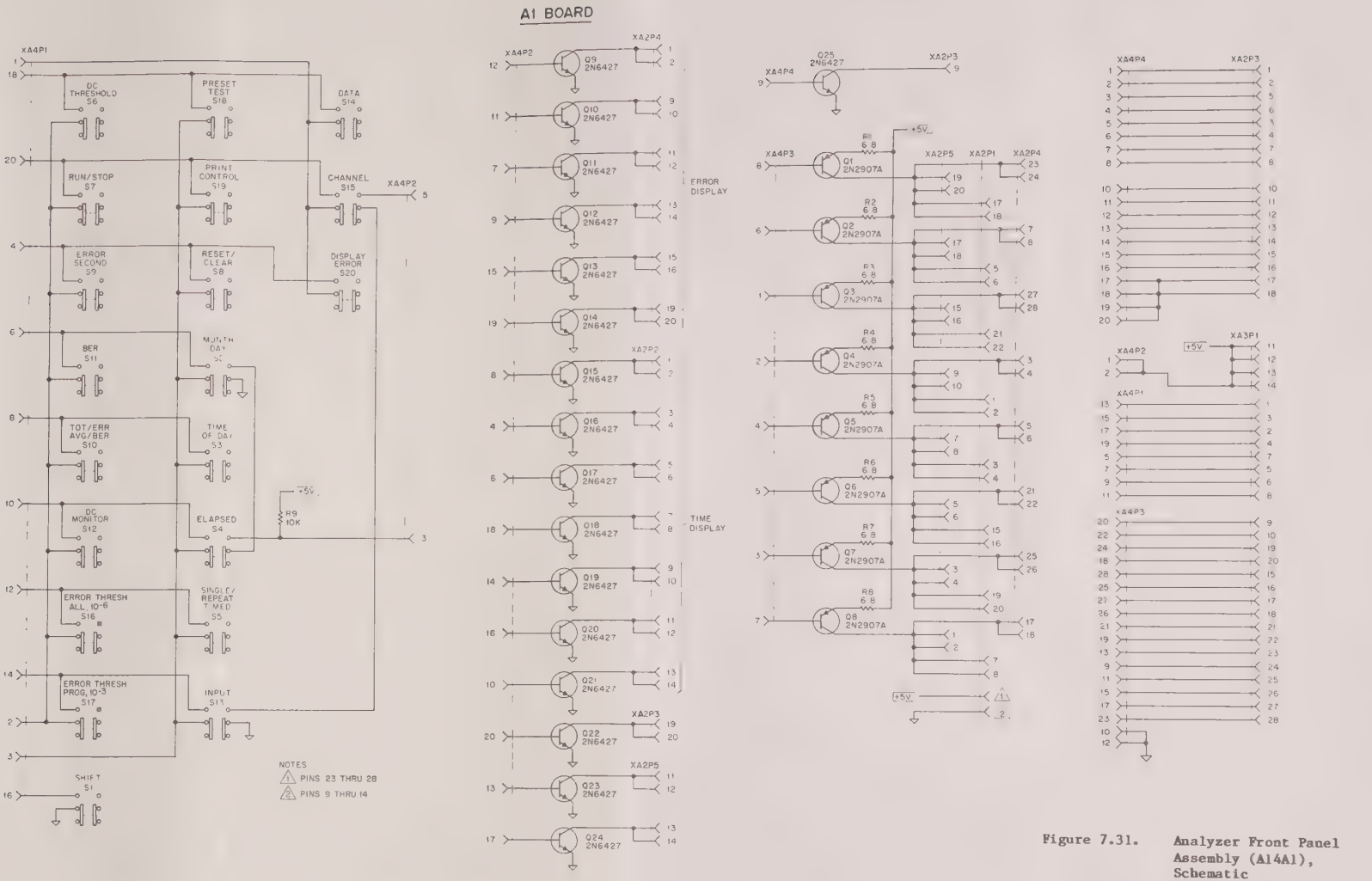


Figure 7.31. Analyzer Front Panel Assembly (A14A1), Schematic (Sheet 3 of 3)

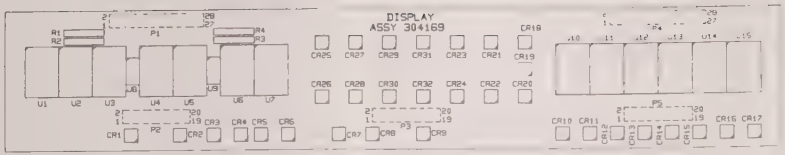
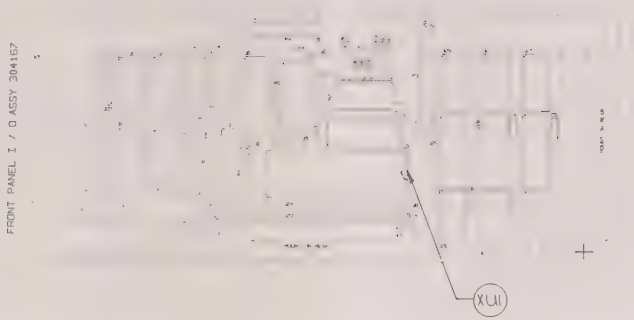


Figure 7.32. Analyzer Front Panel Display Assembly (A14A2), Component Location

304169

Figure 7.33. Analyzer Front Panel Indicator Assembly (A14A3), Component Location

304171

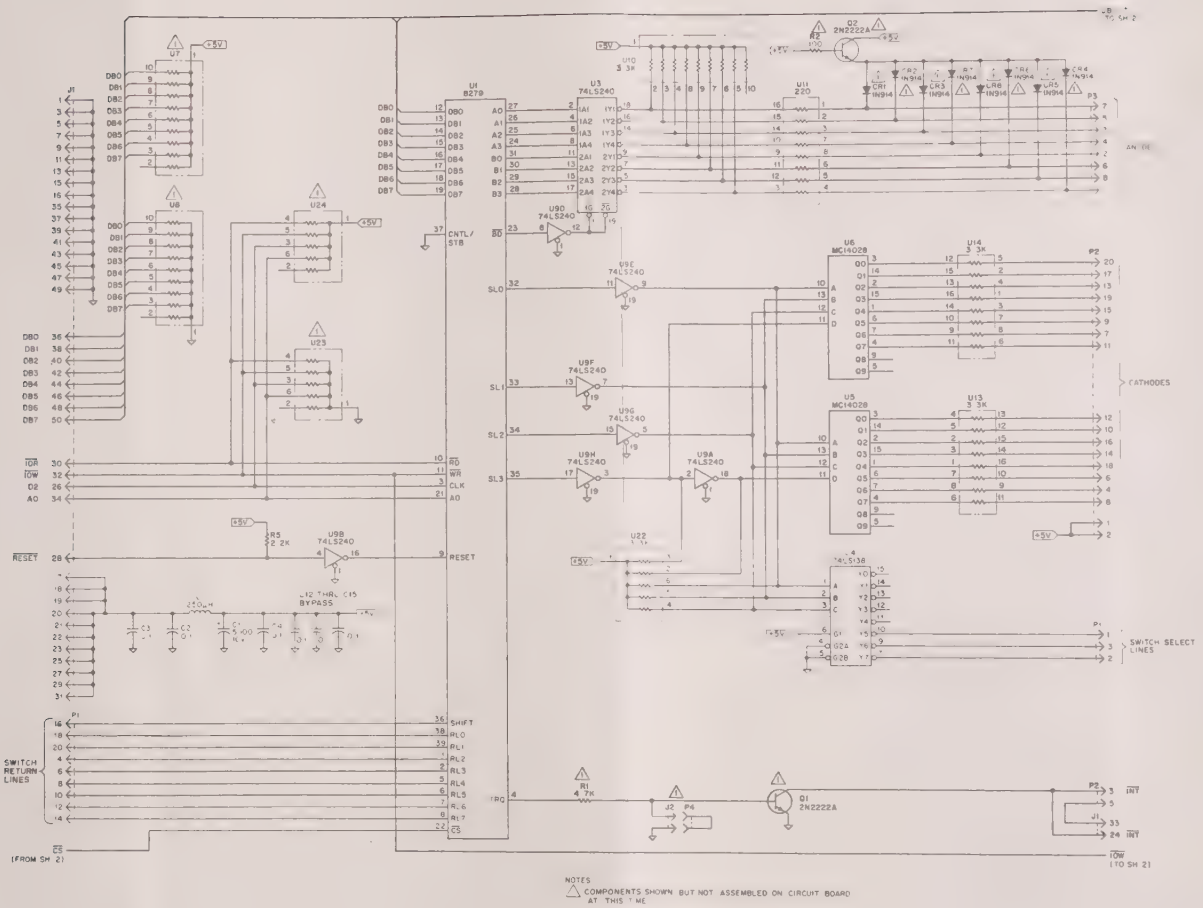


NOTES:

1. THE FOLLOWING COMPONENTS ARE SHOWN BUT NOT INSTALLED:
   CR1 THRU CR8 Q1, Q2, J2, R1, U12, U15, U23, U24, U7 & U8

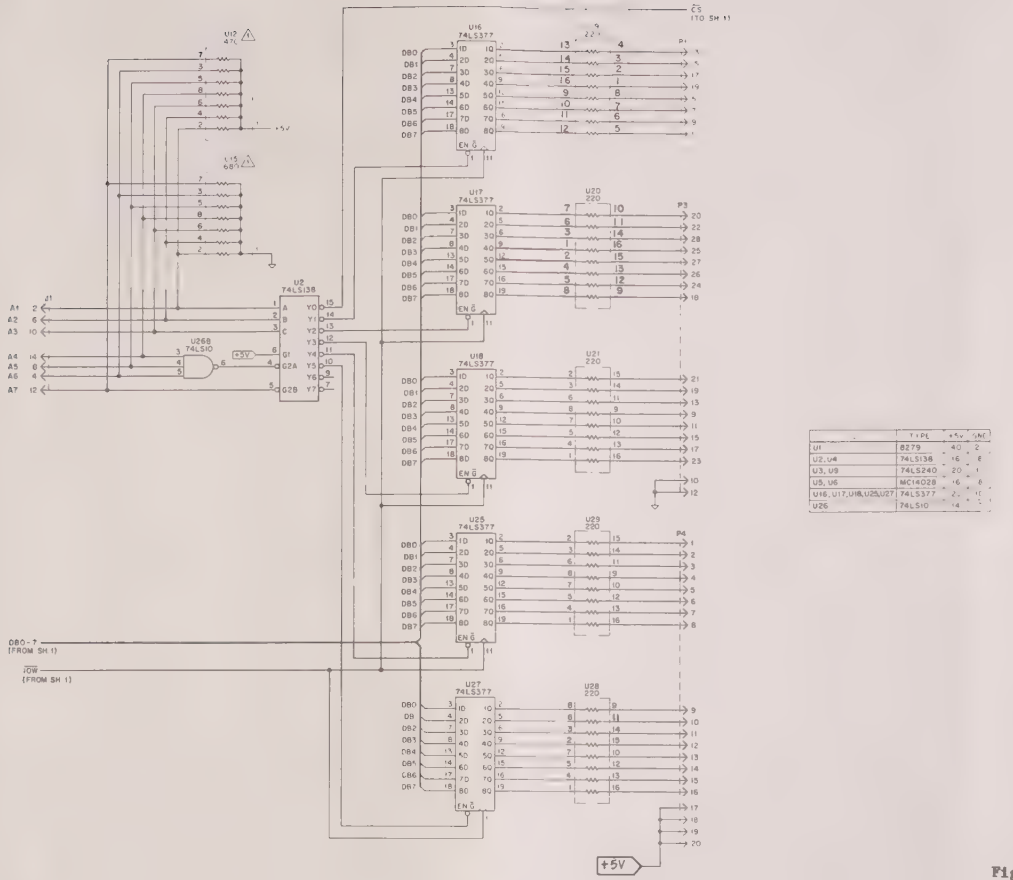
304167C
35G039B

Figure 7.34. **Analyzer Front Panel Assembly I/O (A14A4), Component Location**



NOTES
△ COMPONENTS SHOWN BUT NOT ASSEMBLED ON CIRCUIT BOARD AT THIS TIME

Figure 7.35. Analyzer Front Panel Assembly I/O Assembly (A14A4), Schematic (Sheet 1 of 2)



	T+PL	+5V	GND
U1	8279	40	2
U2,U4	74LS138	16	8
U3,U9	74LS240	20	10
U5,U6	MC14028	16	8
U16,U17,U18,U25,U27	74LS377	20	10
U26	74LS10	14	7

Figure 7.35. Analyzer Front Panel Assembly I/O Assembly (A14A4), Schematic (Sheet 2 of 2)

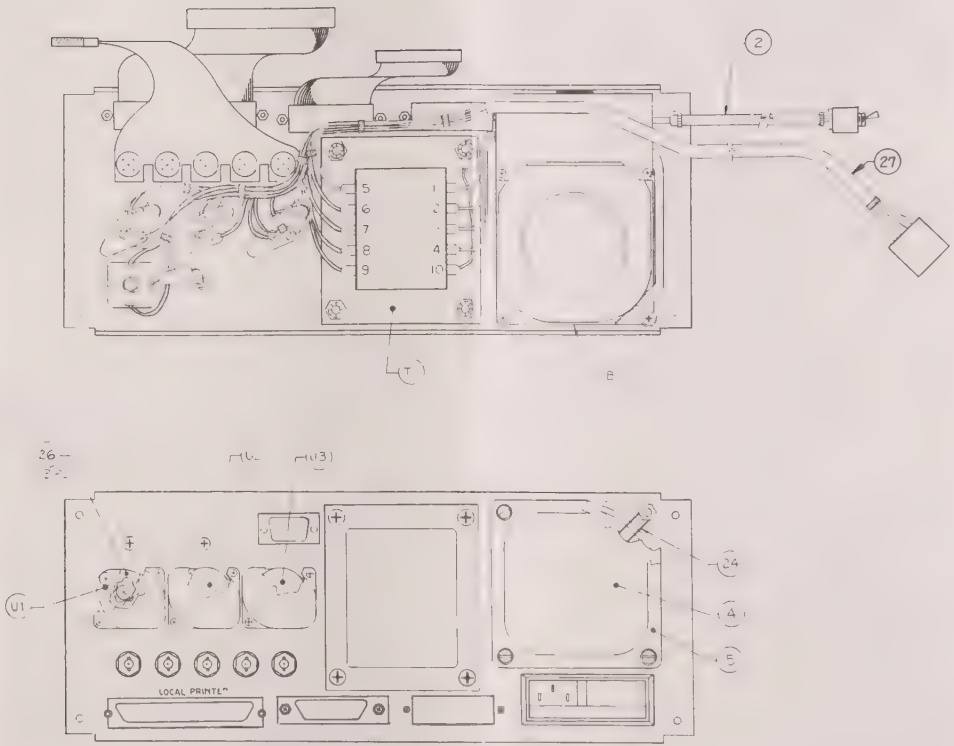


Figure 7.36. Analyzer Rear Panel Assembly (A15) (AC Version Only), Component Location

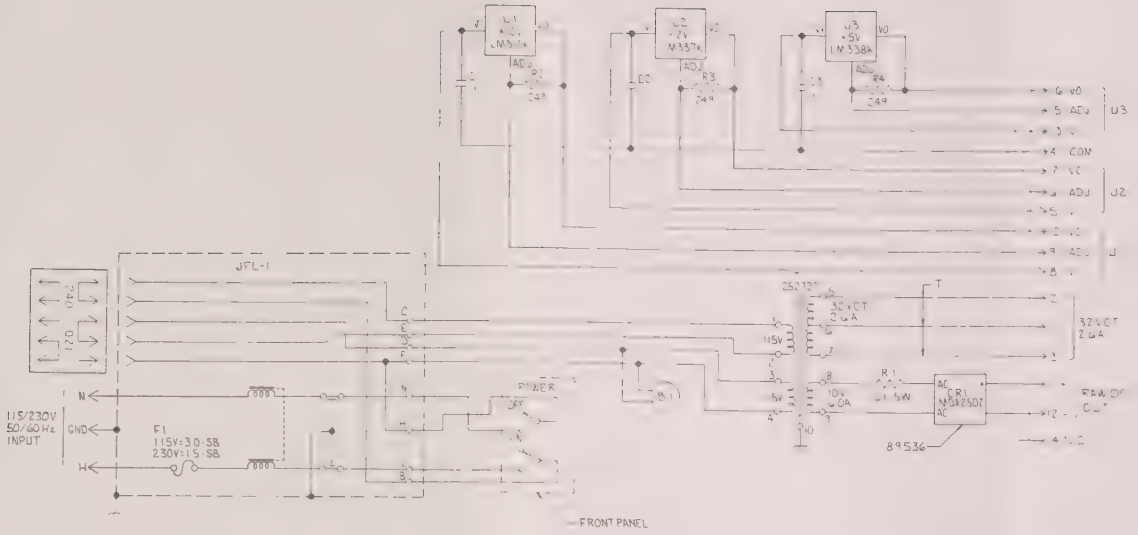


Figure 7.37. Analyzer Rear Panel Assembly (A15) (AC Version Only), Schematic

252734A

35G039Z

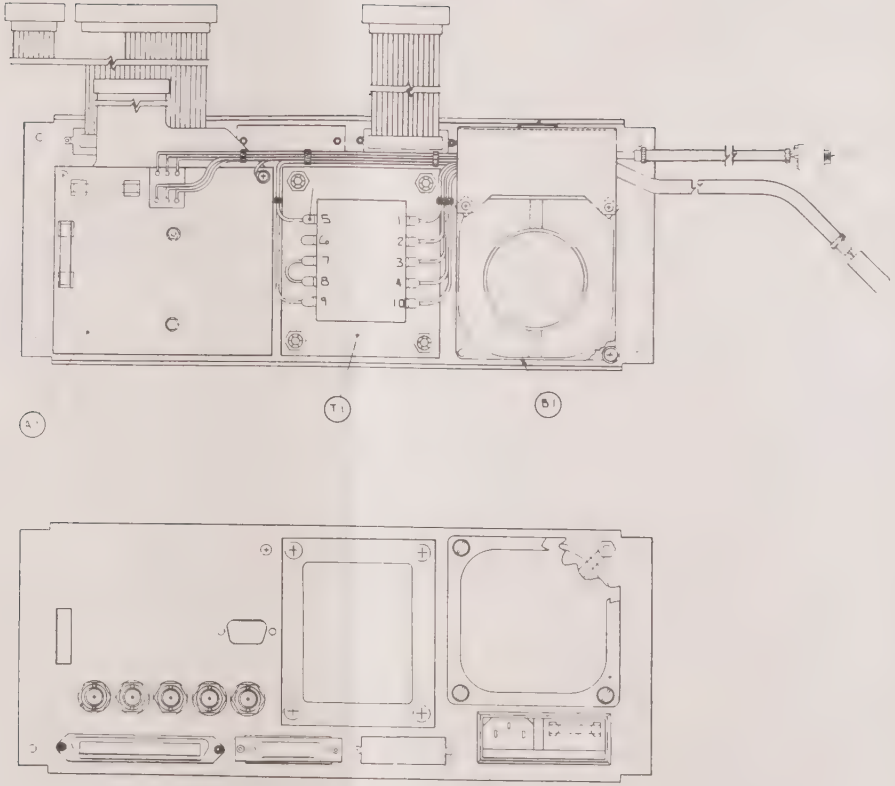
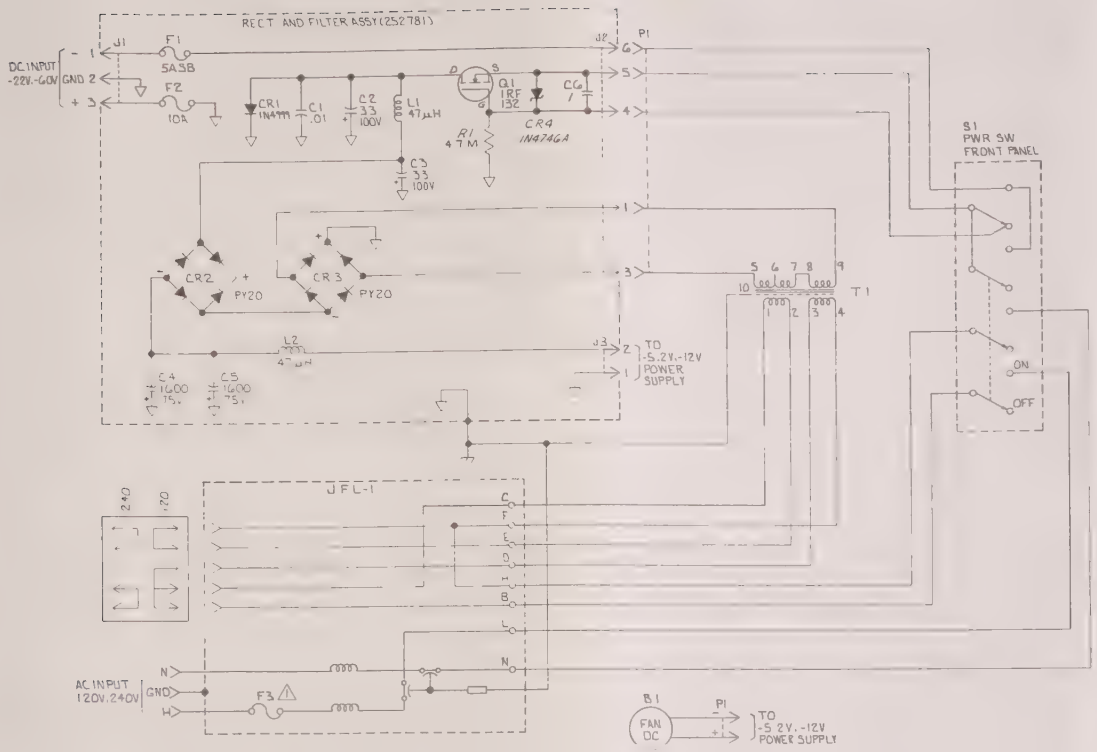


Figure 7.38. Analyzer Rear Panel Assembly (A15) (AC/DC Version Only), Component Location



NOTES

⚠

FUSE CHART		
MODEL	F3	
	120 VAC	240 VAC
4653	1 ASB	½ ASB
4654	½ ASB	¼ ASB
4656	ASB	½ ASB
4651A	1ASB	½ ASB
4652A	2½ASB	1¼ASB

Figure 7.39. Analyzer Rear Panel Assembly (A15) (AC/DC Version Only), Schematic

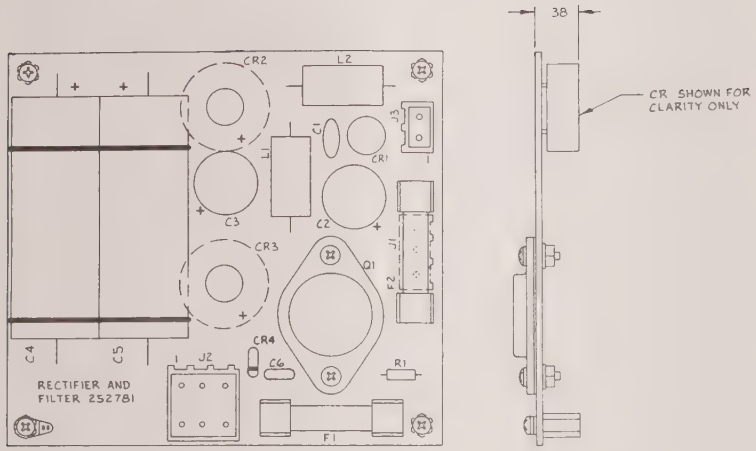
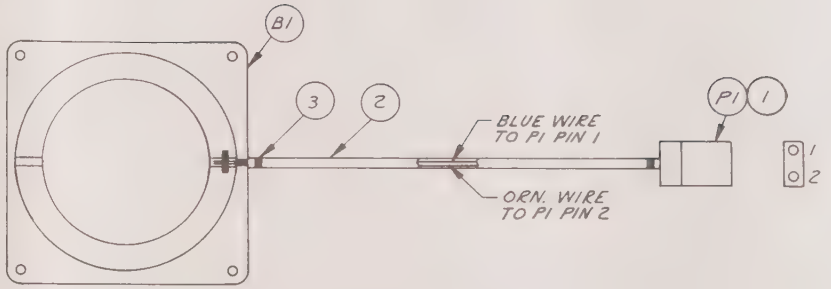


Figure 7.40. Analyzer Rectifier and Filter Assembly (A15A1) (AC/DC Version Only), Component Location



B1	1	89647	FAN	9.5-14 VDC		
P1	1	87358	CONN. HOUSING, RECT.	2 CKT., BLUE	1-480-720-6	
3	2	73045	CABLE TIE	4 IN. LONG		
2	.9FT	73212	TUBING, VINYL	8 AWG.		
1	2	86010	CONN. CONTACT, FEM.		60617-5	
ITEM OR FIG NO	QTY REQD	S A STOCK NO	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE	IDENTIFYING OR PART NO	CODE IDENT

Figure 7.41. Analyzer Rear Panel Fan Assembly (A15B1) (AC/DC Version Only)

252781D

35G039Z

220951

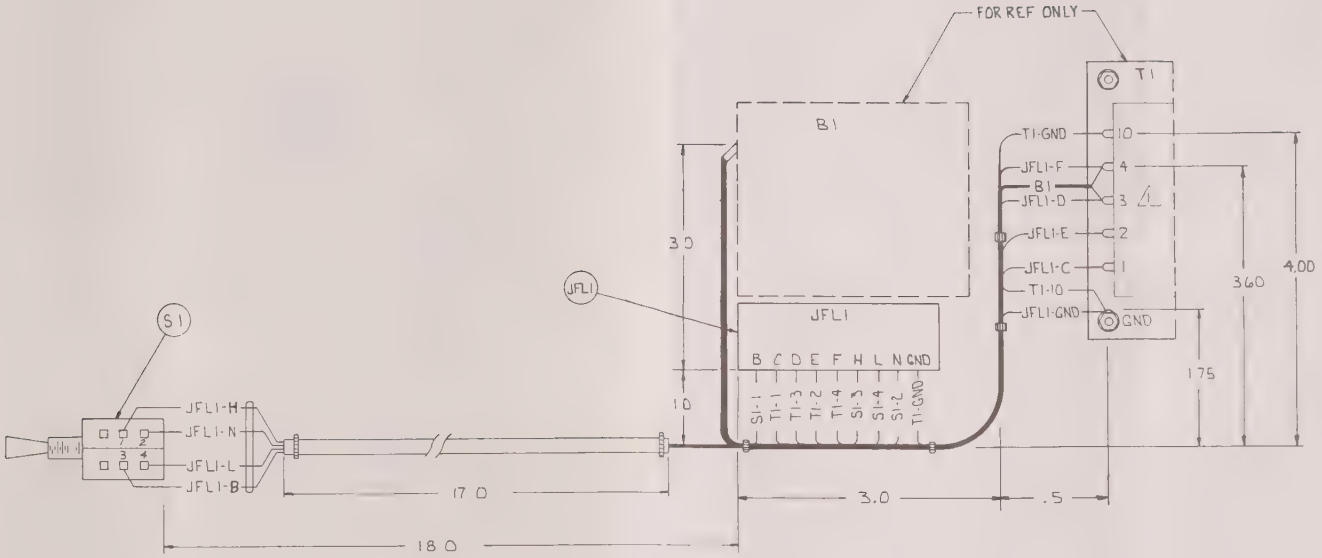
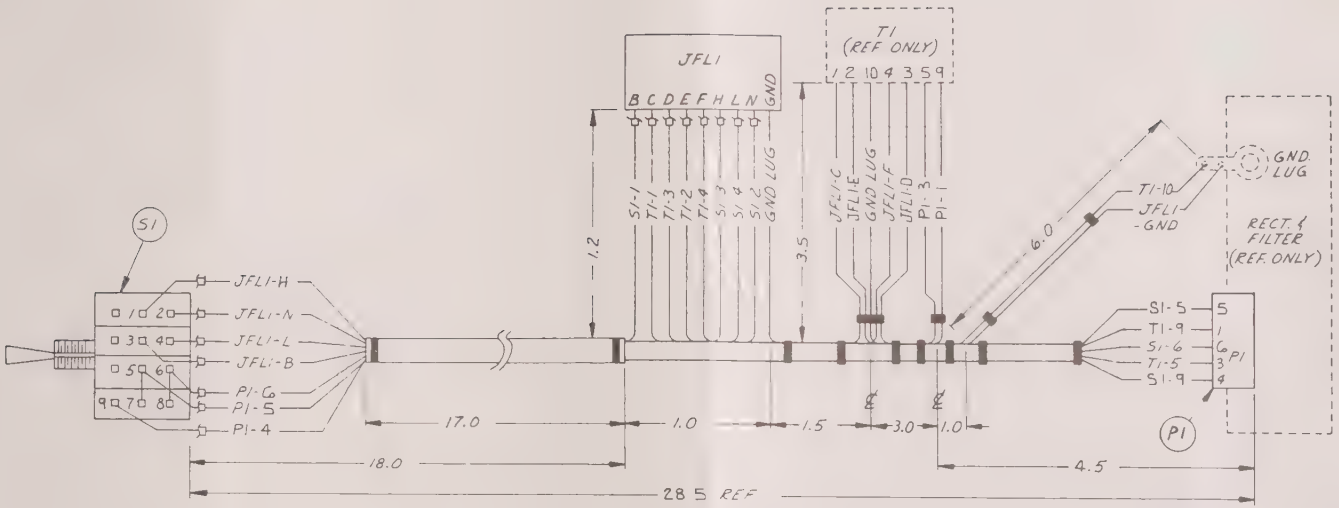


Figure 7.42. Analyzer Power Wiring Harness External Power Sources (AC Version Only)

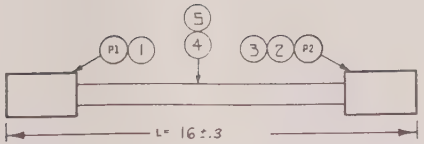


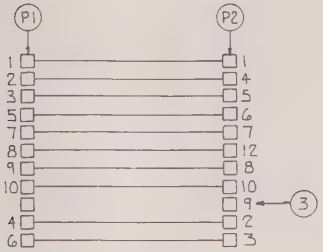
JFL1	1	83759	CONN., AC, 3 COND.	MALE W/FUSE BLK & FILT.	6J4
P1	1	82767	CONN. HOUSING, RECT.	POS. LOCK, 9 CKT.	1-480722-0
S1	1	170261	SWITCH, 4PDT		
7	2FT	73318	WIRE, BUS	22 AWG	
6	.7FT	75929	TUBING, HEAT SHRINK	.125 ID	
5	14FT	73208	TUBING, VINYL	9 AWG	
4	5	86010	CONN. CONTACT, FEM.		60617-5
3	13	73095	CABLE TIE	9 IN. LONG	
2	7FT	73356	WIRE, STRD., WHT.	18 AWG	
1	147FT	73374	WIRE, STRD., WHT.	20 AWG	

Figure 7.43. Analyzer Power Wiring Harness External Power Sources (AC/DC Version Only)

252782A

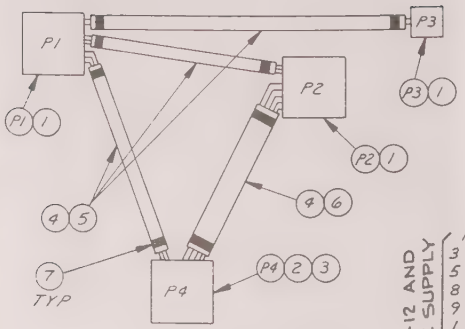
35G039Z



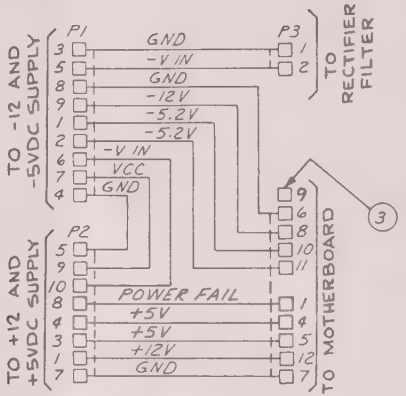


ITEM OR FIND NO	QTY REQD	S-A STOCK NO	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE	IDENTIFYING OR PART NO
5	1.3FT	73207	TUBING, VINYL	2 AWG	
4	14FT	73356	WIRE, STRD. WHT	18 AWG	
3	1	87429	PLUG, KEYING		87116-2
2	10	89565	CONN. CONTACT. FEM	18-22 AWG	87027-3
1	10	86010	CONN. CONTACT. FEM	18-22 AWG	60617-5
P2	1	89674	CONN. HOUSING RECT	12 CKT	1-87025-1
P1	1	87046	CONN HOUSING. RECT	FREE HANGING. 10CKT	1-480285-0

Figure 7.44. Analyzer Power Wiring Harness (AC Version Only)



CABLE FROM-TO	WIRE LENGTH	TUBING LENGTH
P1 - P2	19 IN.	17 IN.
P1 - P3	21 IN	19 IN.
P1 - P4	16 IN.	14 IN.
P2 - P4	14 IN.	12 IN.



ITEM OR FIND NO	QTY REQD	S-A STOCK NO	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE	IDENTIFYING OR PART NO
P4	1	89674	CONN. HOUSING, RECT.	12 CKT.	1-87025-1
P3	1	87352	CONN. HOUSING, RECT.	POS. LOCK, 2 CKT.	1-480720-0
P2	1	70256	CONN. HOUSING, RECT.	FREE HNG., 10 CKT.	1-480285-2
P1	1	87046	CONN. HOUSING, RECT.	FREE HNG., 10 CKT.	1-480285-0
7	8	73045	CABLE TIES	4 IN. LONG	
6	.8FT	73207	TUBING, VINYL	2 AWG	
5	3.5FT	73212	TUBING, VINYL	8 AWG	
4	14.7FT	73356	WIRE, STRD., WHT.	18 AWG	
3	1	87429	KEY		87116-2
2	9	89565	CONN. CONTACT, FEM.		87027-3
1	19	86010	CONN. CONTACT, FEM.		60617-5

Figure 7.45. Analyzer Power Wiring Harness (AC/DC Version Only)

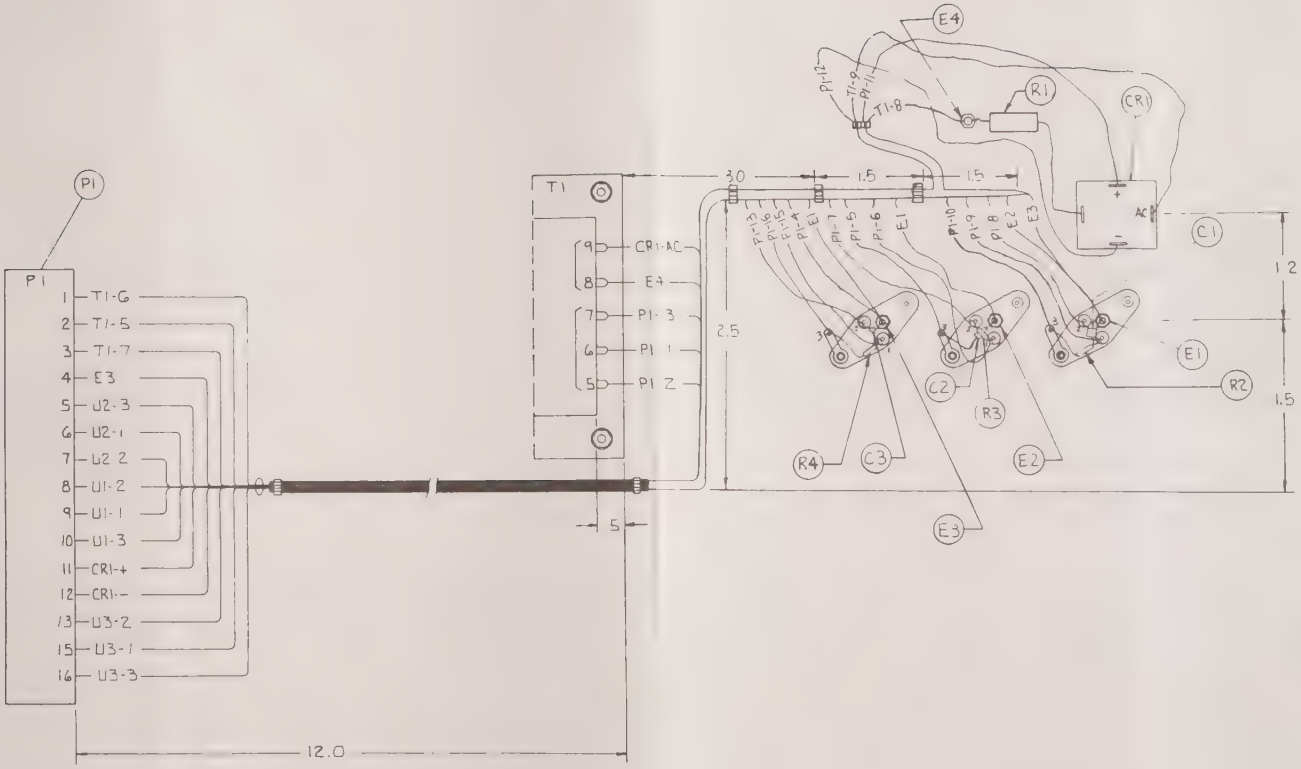
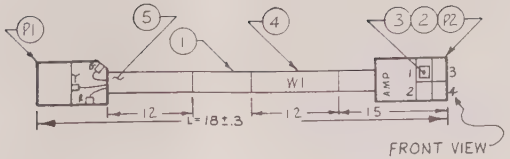


Figure 7.46. Analyzer Power Regulator Wiring Harness (AC Version Only)

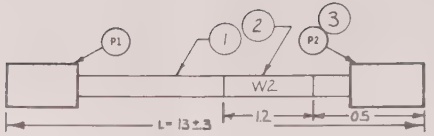


ITEM OR FIND NO	QTY REQD	S-A STOCK NO	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE	IDENTIFYING OR PART NO	FSCM NO
5	.1FT	77936	TUBING HEAT SHRINK	.187 DIA	FIT-221-3/16 BLK	
4	.1FT	85219	TUBING HEAT SHRINK	.250 DIA	RT-876 WH 1/4D	
3	1	86944	PLUG KEYING		87179-1	
2	3	82955	CONN CONTACT	22-26 AWG	87165-1	
1	1.5FT	70380	CABLE	2 COND, 22 AWG, SH 24 AWG	8451	
P2	1	83393	CONN BODY W/O INSERTS	4 HOLES	87133-1	
P1	1	84013	JACK, PHONE	3-COND 3 CONTACTS	112B	

Figure 7.47. Analyzer DS1/1C/2 Input Cable Assembly (W1)

2528068

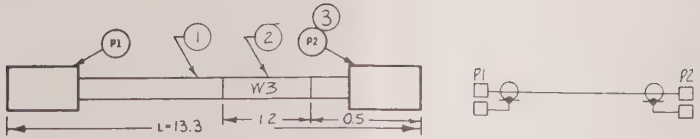
35G039Z



ITEM OR FIND NO	QTY REQD	S-A STOCK NO	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE	IDENTIFYING OR PART NO	FSCM NO
3	1	171520	CONNECTOR FERRULE	.110 CBL	328666	
P2	1	171519	CONNECTOR, COAX PIN	.110 CBL	201143-1	
P1	1	84353	CONN, COAX - BNC FEM	.110 CBL 75Ω	31-318 NI PLATED	
2	.1FT	85219	TUBING, HEAT SHRINK	.250 I.D	RT-876 WH 1/4D	
1	1.1FT	73835	CABLE, COAX	75Ω .110 OD	RG 187 A/U	

Figure 7.48. Analyzer NRZ Clock Input Cable Assembly (W2)

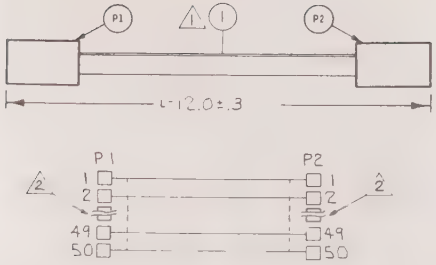
252809



ITEM OR FIND NO	QTY REQD	S-A STOCK NO	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE	IDENTIFYING OR PART NO
3	1	171520	CONNECTOR FERRULE	.110 CBL	328666
P2	1	171519	CONNECTOR,COAX PIN	.110 CBL	201143-1
P1	1	84353	CONN,COAX BNC FEM	.110 CBL 75Ω	31-318 NI PLATED
2	.1FT	85219	TUBING, HEATSINK	.250ID	RT 876 WH ¼D
1	1.1FT	73835	CABLE,COAX	75Ω .110 OD	RG 187 A/U

Figure 7.49. Analyzer NRZ Data Input Cable Assembly (W3)

252815



NOTES

1. RED LINE DENOTES PIN 1
2. PINS ON P1 CONNECTED TO IDENTICAL PINS ON P2

ITEM OR FIND NO	QTY REQD	S-A STOCK NO	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE
P2	1	84379	CONN FLAT. 50 PIN	FEM
P1	1	84379	CONN FLAT. 50 PIN	FEM
1	.1 FT	84305	CABLE.FLAT 50 COND	28 AWG

Figure 7.50. Analyzer Front Panel I/O Cable Assembly (W4)

252783A

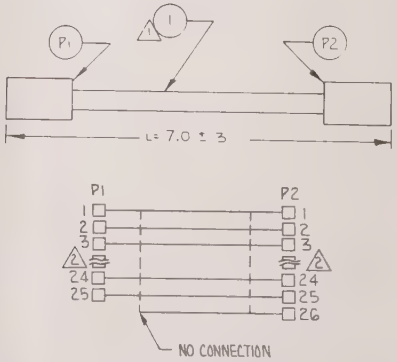


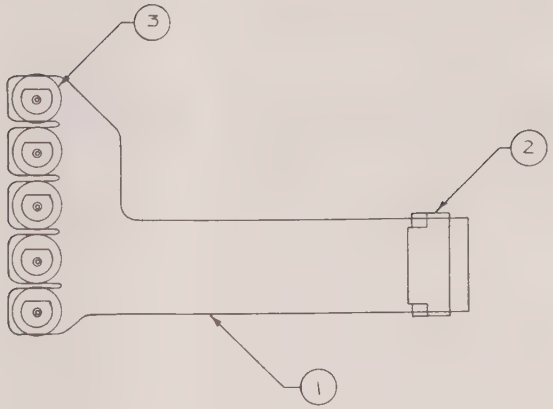
Figure 7.51. Analyzer Demux I/O Cable Assembly

252791C

ITEM OR FIND NO	QTY REQD	S-A STOCK NO	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE
2	1	83300	PLUG,KEYING	
1	.7FT	82495	CABLE,FLAT RIBBON	26 COND.
P2	1	170223	CONN,FLAT FEMALE	26 PIN
P1	1	86241	CONN,FLAT MALE	CABLE,FLAT 25 2E PIN CO

NOTES:

1. REDLINE DENOTES PIN 1
2. PINS ON P1 CONNECTED TO IDENTICAL PINS ON P2.
3. INSERT ITEM 2 IN THIS LOCATION



ITEM OR FIND NO	QTY REQD	S-A STOCK NO	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE	IDENTIFYING OR PART NO	FSCM NO
3	5		CONN			
2	1	170210	CONN FEM FLAT CABLE	12 PIN		
1	1	252766	FLEX CKT			

Figure 7.52. Analyzer Auxiliary Interface Flex Circuit Cable Assembly

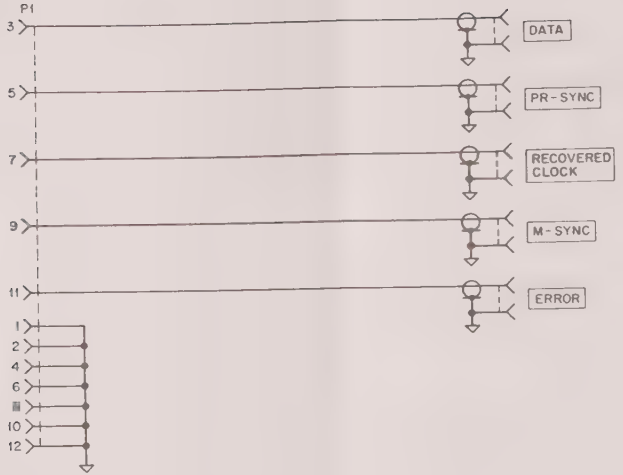


Figure 7.53. Analyzer Auxiliary Interface Flex Circuit Cable Assembly, Schematic

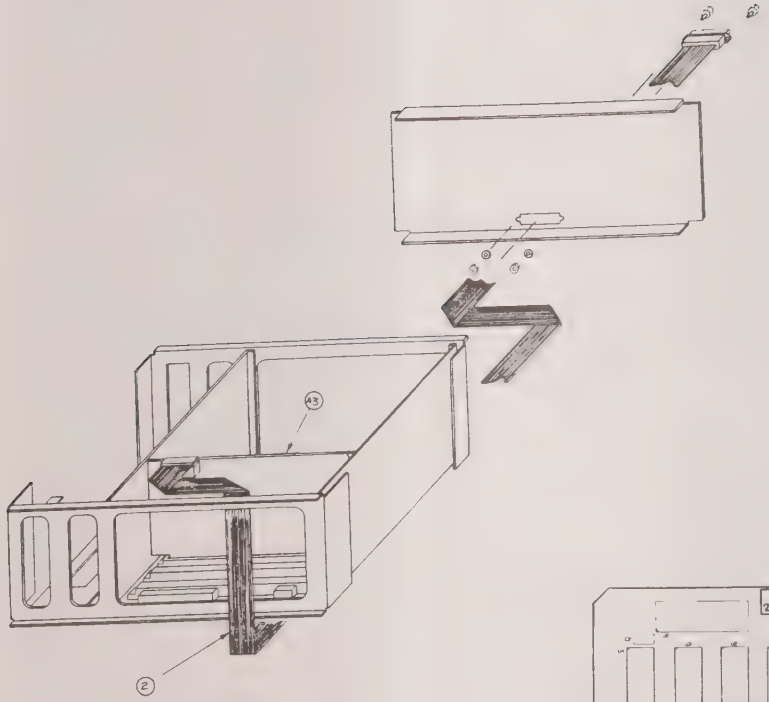
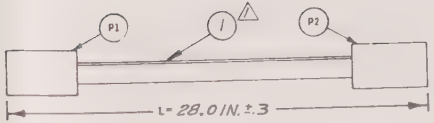
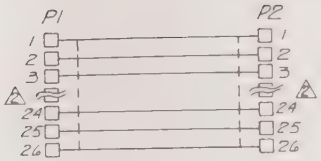


Figure 7.54. Analyzer Option 304208 IEEE-488 Interface, Installation Assembly Diagram

304208



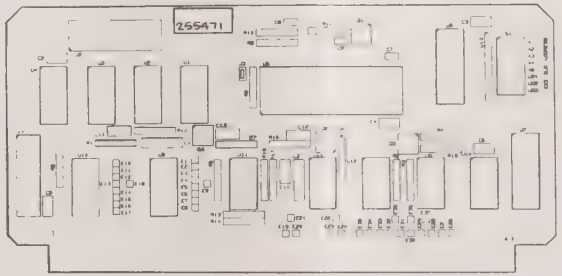
NOTES:
1. RED LINE DENOTES PIN 1.
2. PINS ON P1 CONNECTED TO IDENTICAL PINS ON P2.



ITEM OR FIND NO.	QTY REQD	S-A STOCK NO.	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE	IDENTIFYING OR PART NO.
P2	1	89630	CONN, FLAT CABLE	24 PIN	1-88377-0
P1	1	88369	CONN, FLAT CABLE	24 PIN	552840-1
1	24FT	88367	CABLE, FLAT RIBBON	24 COND	

Figure 7.55. Analyzer Option 304208 IEEE-488 Interface Cable Assembly

220981A



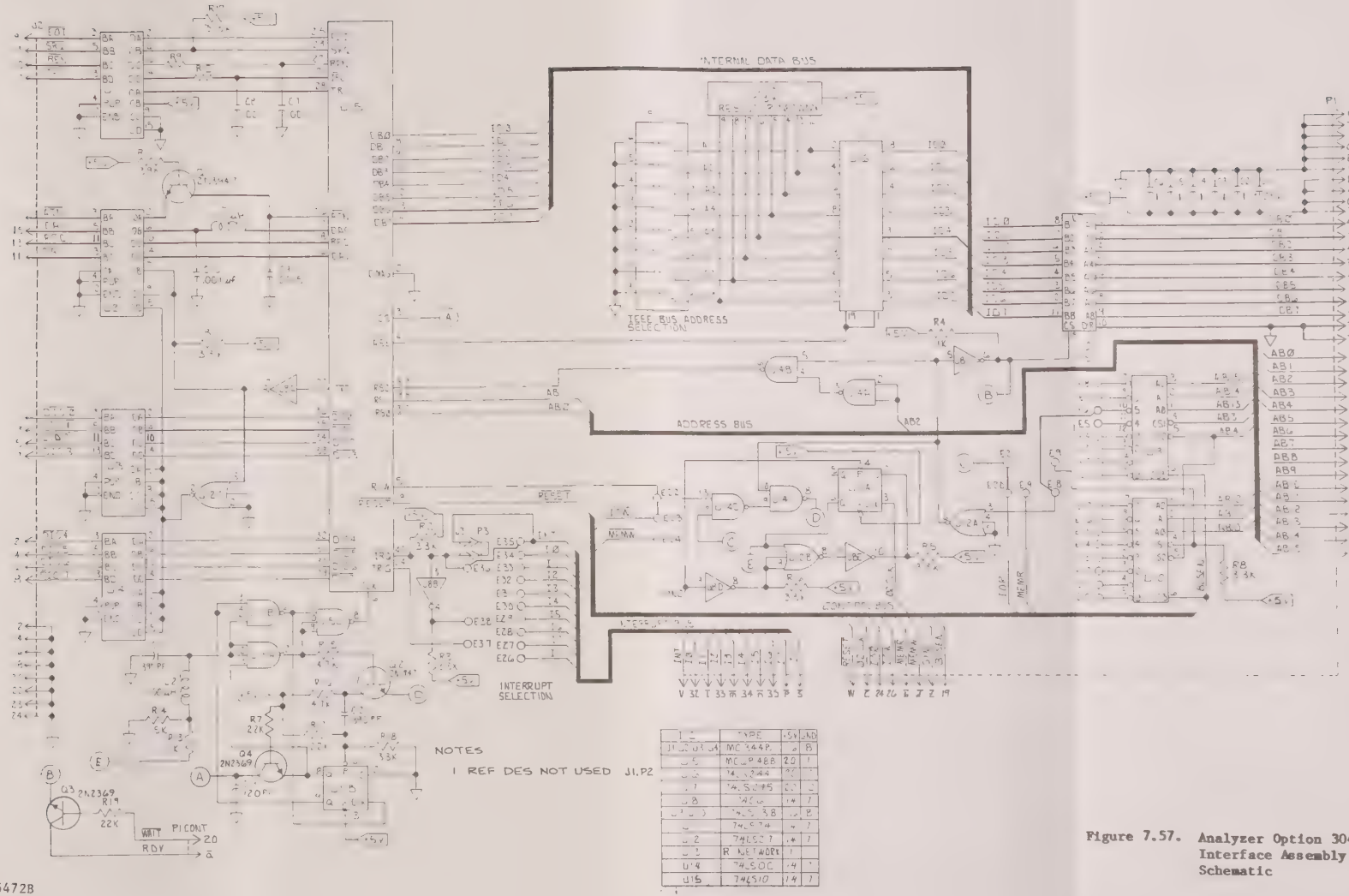
JUMPER INSTALLATION CHART

E6 TO E18
E20 TO E21
E22 TO E23
E35 TO E36

NOTES:
1. REF DES NOT USED: J1, P2, XU13

Figure 7.56. Analyzer Option 304208 IEEE-488 Interface Assembly (A3), Component Location

255471A



	TYPE	+5V	GND
U1	MC 3448 P	8	8
U2	MC 3488	20	1
U3	74LS244	20	1
U4	74LS245	20	1
U5	7406	14	7
U6	74LS38	14	7
U7	7414	14	7
U8	74LS27	14	7
U9	RESISTOR	1	
U14	74LS06	14	7
U15	74LS10	14	7

Figure 7.57. Analyzer Option 304208 IEEE-488 Interface Assembly (A3), Schematic

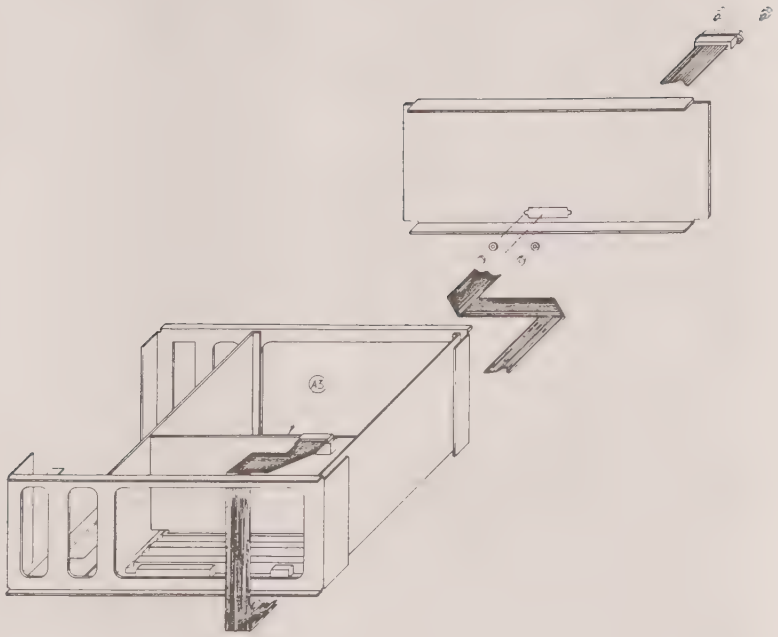
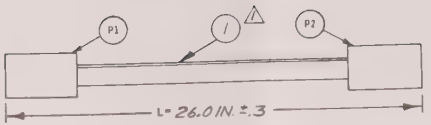
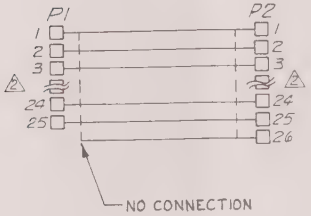


Figure 7.58. **Analyzer Option 304209 RS-232C Interface, Installation Assembly Diagram**

304209





NOTES:
1. RED LINE DENOTES PIN 1.
2. PINS ON P1 CONNECTED TO IDENTICAL PINS ON P2.

ITEM OR FIND NO	QTY REQD	SA STOCK NO	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE	IDENTIFYING OR PART NO
P2	1	170223	CONN, FLAT FEMALE	26 PIN	88377-5
P1	1	86242	CONN, FLAT FEMALE	25 TO 26 PIN COND FLAT CABLE	206770-1
1	22FT	82495	CABLE, FLAT RIBBON	26 COND	

Figure 7.59. **Receiver Option 304209 RS-232C Interface Cable Assembly**

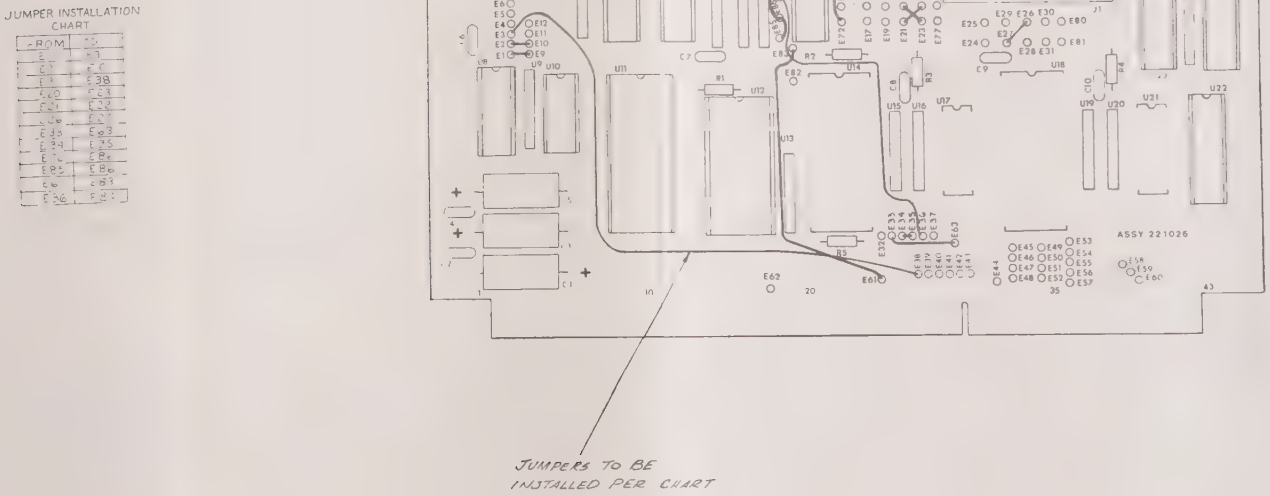


Figure 7.60. Analyzer Option 304209 RS-232C Interface Assembly (A3), Component Location

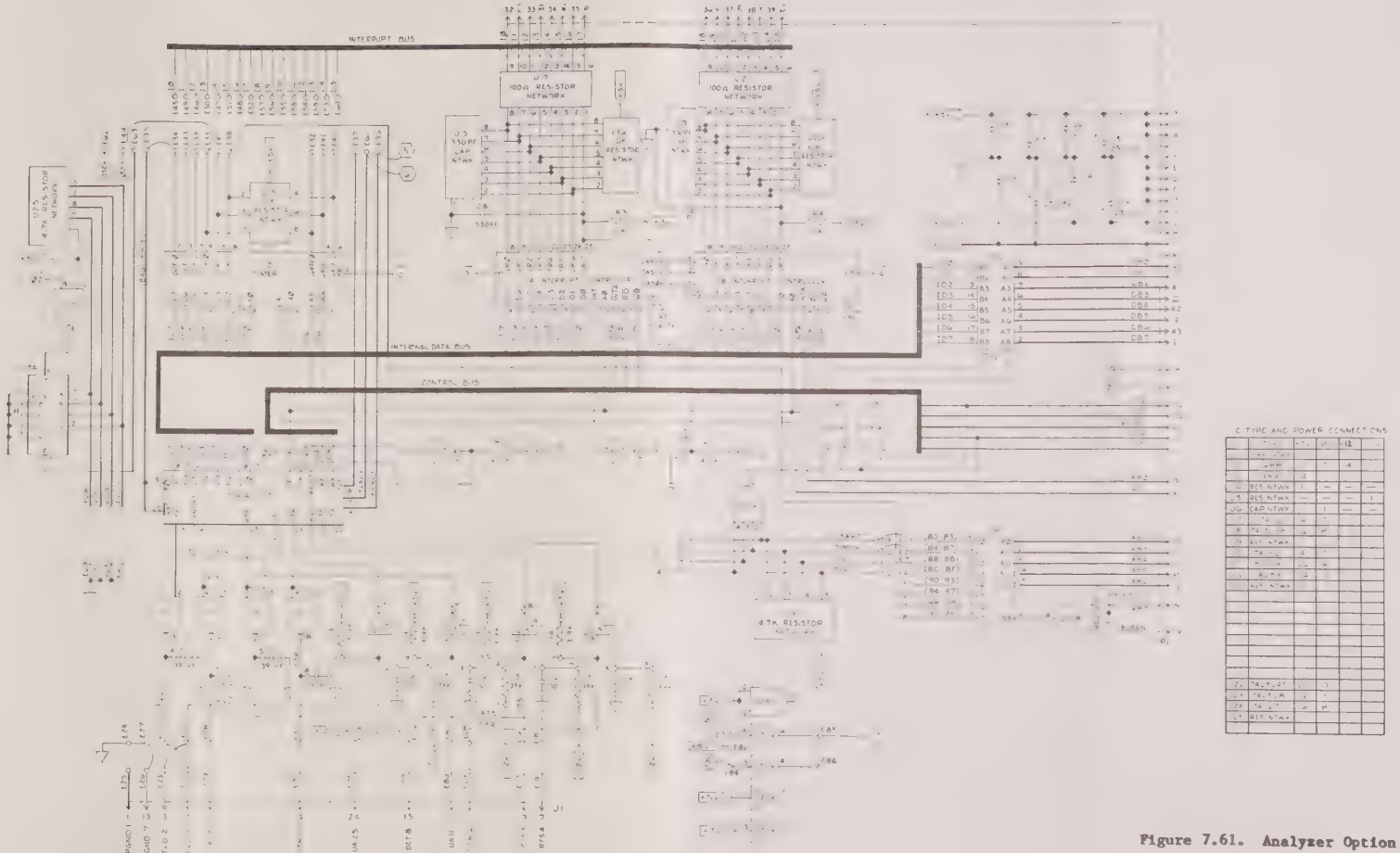


Figure 7.61. Analyzer Option 304209 RS-232C Interface Assembly (A3), Schematic

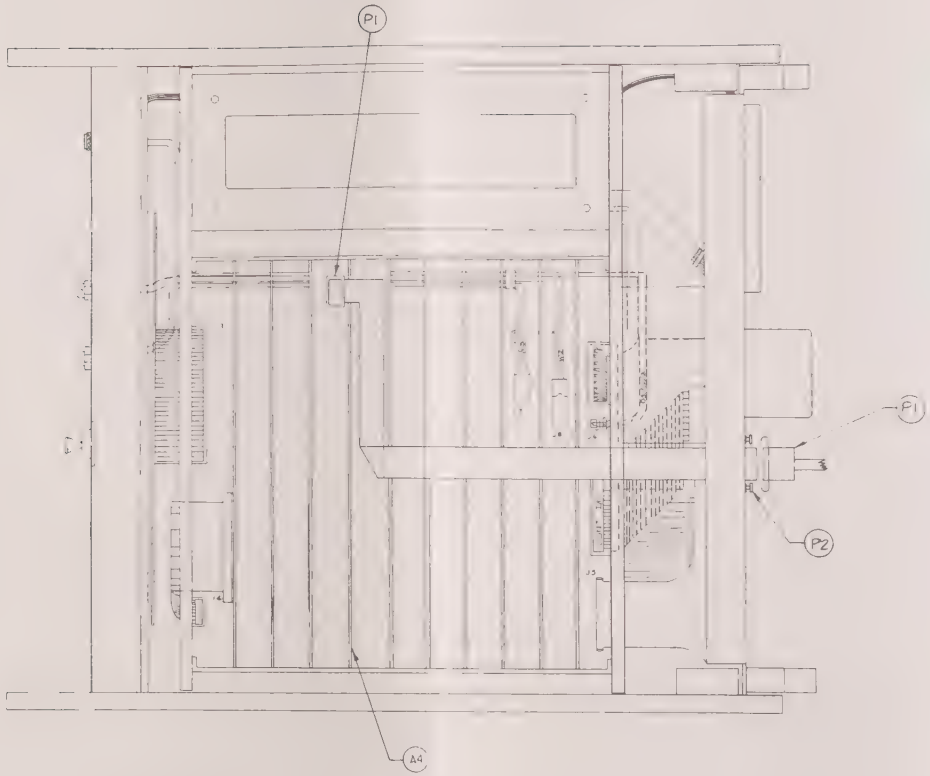


Figure 7.62. Analyzer Option 304210 External Monitor Option Interface-Installation Assembly Diagram

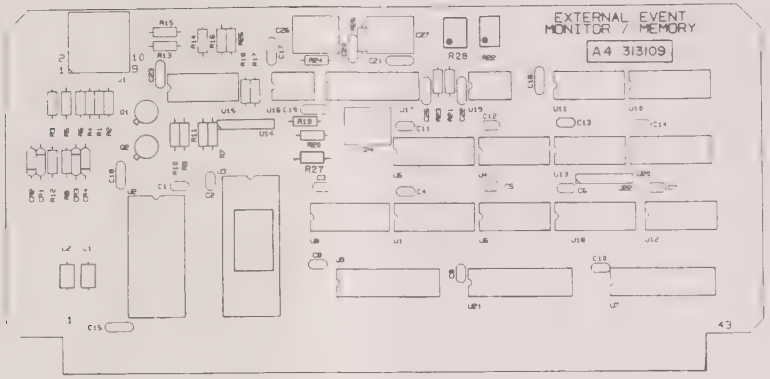
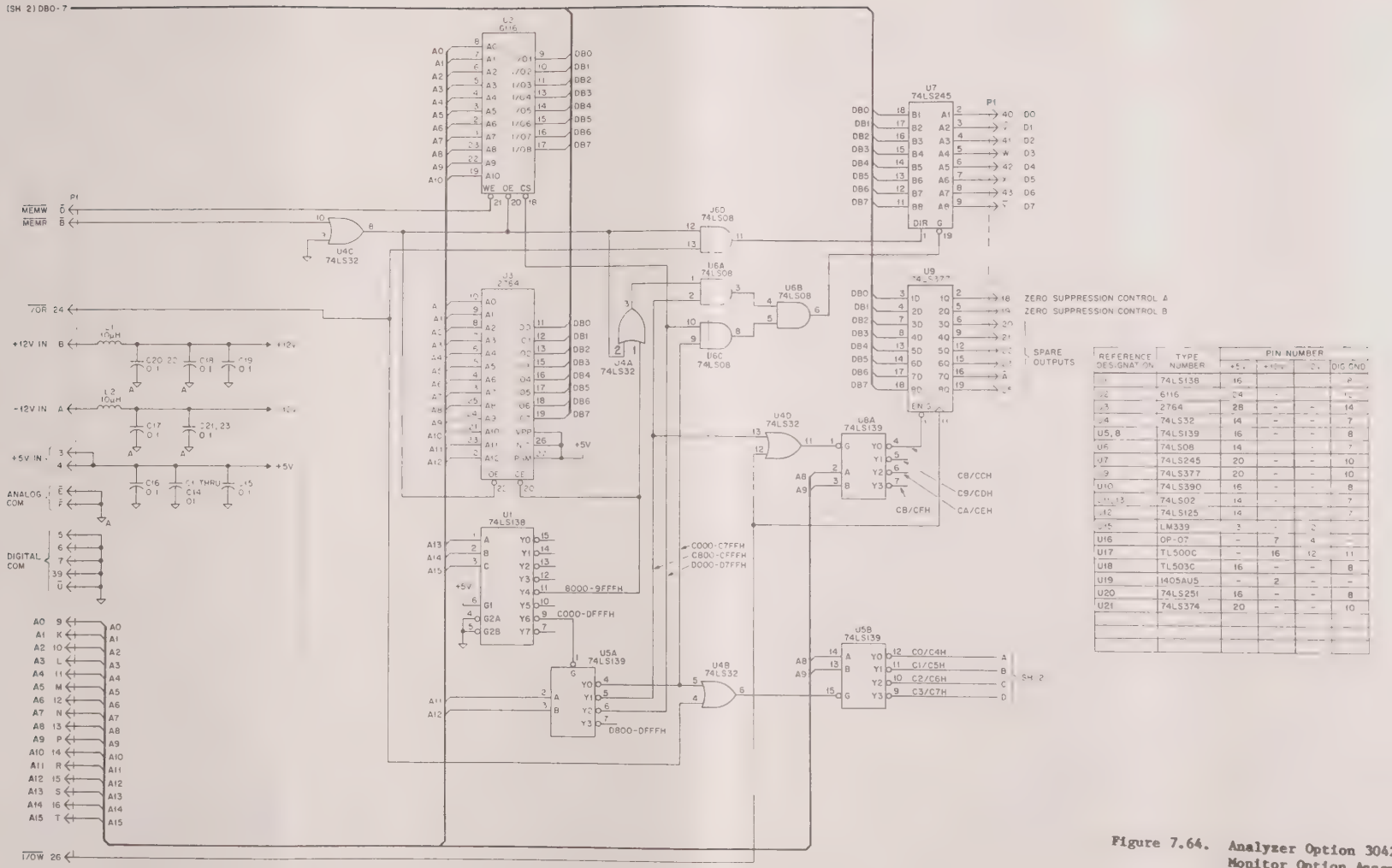


Figure 7.63. Analyzer Option 304210 External Monitor Option Assembly (A4), Component Location



REFERENCE DESIGNATION	TYPE NUMBER	PIN NUMBER			
		+5 V	+12V	-12V	DIG GND
U1	74LS138	16	-	-	8
U2	6116	24	-	-	12
U3	2764	28	-	-	14
U4	74LS32	14	-	-	7
U5, 8	74LS139	16	-	-	8
U6	74LS08	14	-	-	7
U7	74LS245	20	-	-	10
U9	74LS377	20	-	-	10
U10	74LS390	16	-	-	8
U11, 13	74LS02	14	-	-	7
U12	74LS125	14	-	-	7
U15	LM339	3	-	2	-
U16	OP-07	-	7	4	-
U17	TL500C	-	16	12	11
U18	TL503C	16	-	-	8
U19	1405AU5	-	2	-	-
U20	74LS251	16	-	-	8
U21	74LS374	20	-	-	10

Figure 7.64. Analyzer Option 304210 External Monitor Option Assembly (A4), Schematic (Sheet 1 of 2)

304146B
35G039B

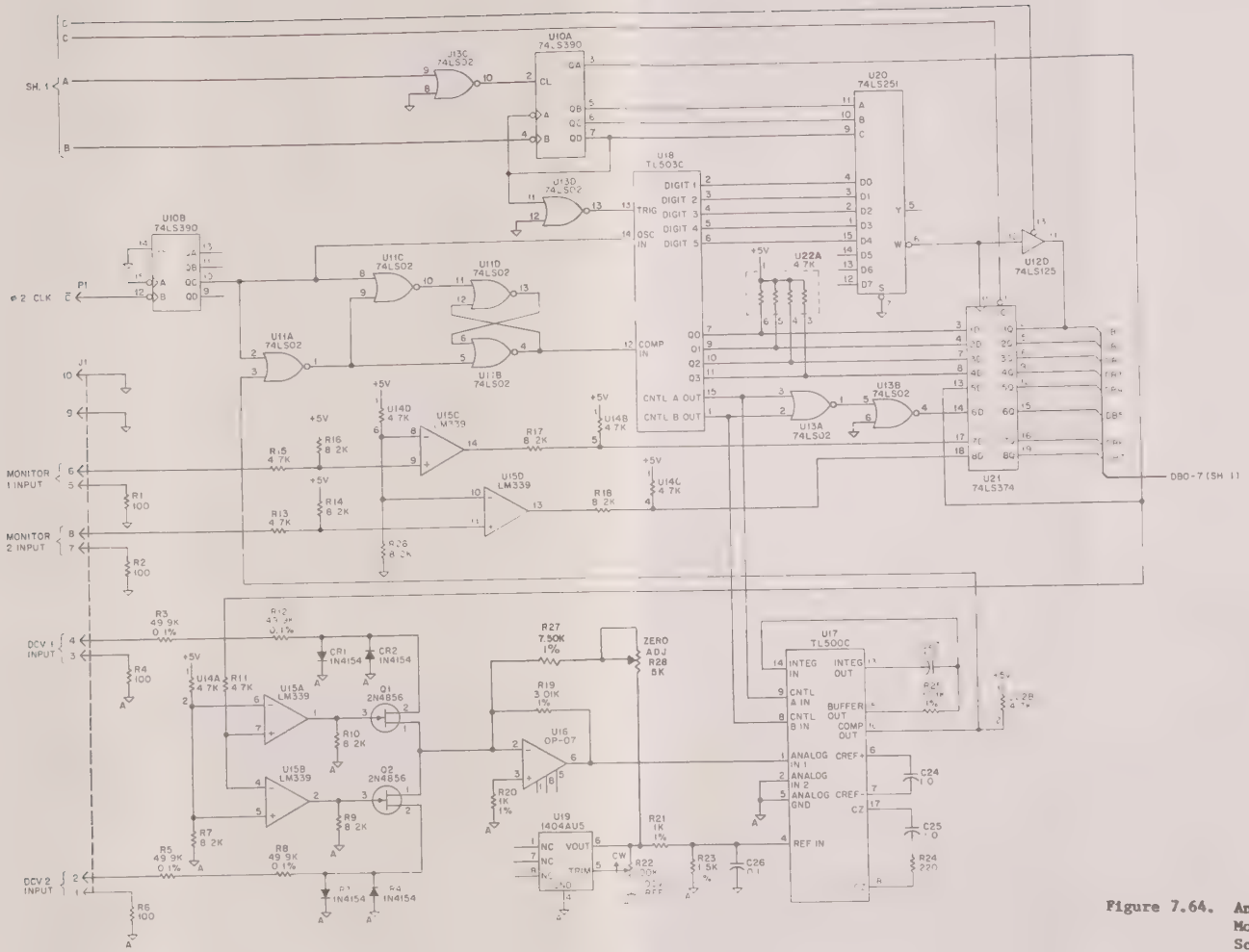
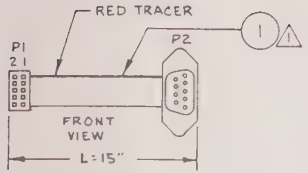
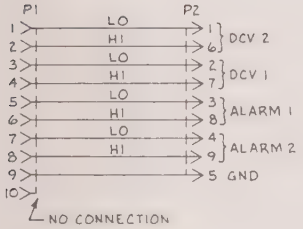


Figure 7.64. Analyzer Option 304210 External Monitor Option Assembly (A4), Schematic (Sheet 2 of 2)

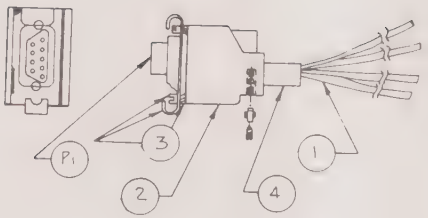


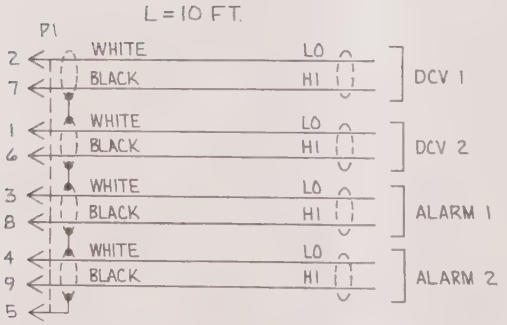


NOTES:
1. RED TRACER INDICATES PIN 1.

ITEM OR FIND NO	QTY REQD	SA STOCK NO	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT'S VALUE	IDENTIFYING OR PART NO
1	1	85130	CABLE, FLT	10 COND 28 AWG	3365/10
P2	1	172236	CONN, RECT MALE W/FLANGE	9 PIN	DE 9P
P1	1	85048	CONN, FLT CABLE	10 PIN	86981-2

Figure 7.65. Analyzer Option 304210 External Monitor Option DCV/ALARM Cable Assembly





ITEM OR FIND NO	QTY REQD	SA STOCK NO	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT'S VALUE	IDENTIFYING OR PART NO
4	1FT	77938	TUBING, HEATSHRINK	.375 ID	FIT-221-3/8 BLK
3	1	173622	CONN, RECT SLIDINGLOCK	SIZE E	DE-51224-1
2	1	173623	CONN, RECT SHELL	SIZE E	DE-51218-1
1	24	78027	CABLE, FOIL SHIELD	2 COND 26 AWG	
P1	1	78944	CONN RECT FEMALE	9 COND	17-80090-16

Figure 7.66. Analyzer Option 304210 External Monitor Option DCV/ALARM Monitor Cable Assembly

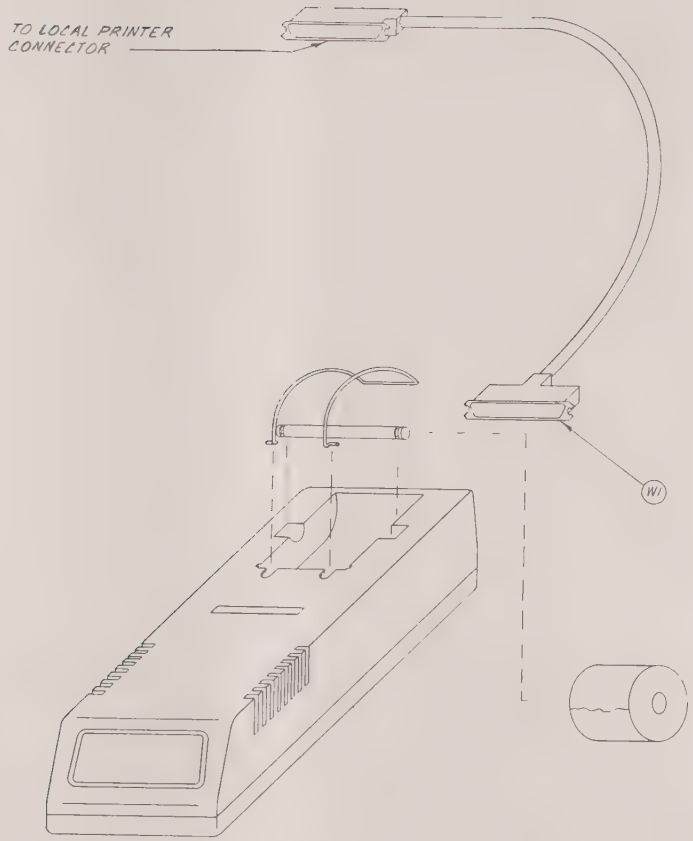
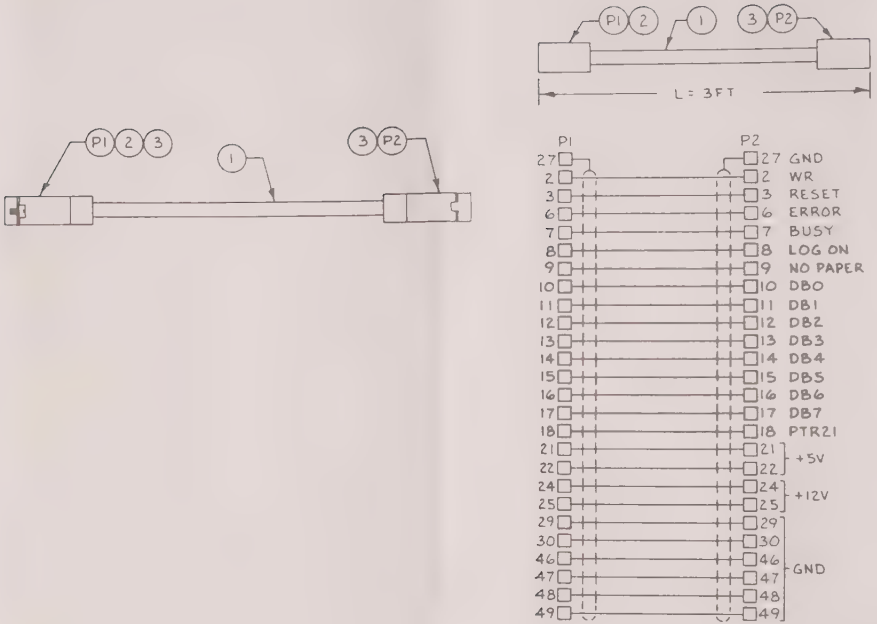


Figure 7.67. Analyzer Option 4650, Local Printer Components



ITEM OR FIND NO	QTY REQD	S A STOCK NO	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE	IDENTIFYING OR PART NO
P2	1	89676	CONN, RECT MALE	50 CONTACTS	552032-1
P1	1	171877	CONN, RECT MALE	50 CONTACTS	229974-1
3	2	85908	CONN, STRAIN RELIEF	STRAIGHT	2-552008-1
2	2	83978	CONN, RECT JACK SCREW		3342-1
1	3FT	170216	CABLE, SHIELDED	25 COND AWG 24	9543

Figure 7.68. Analyzer Option 4650 Local Printer Interface Cable Assembly (W1)

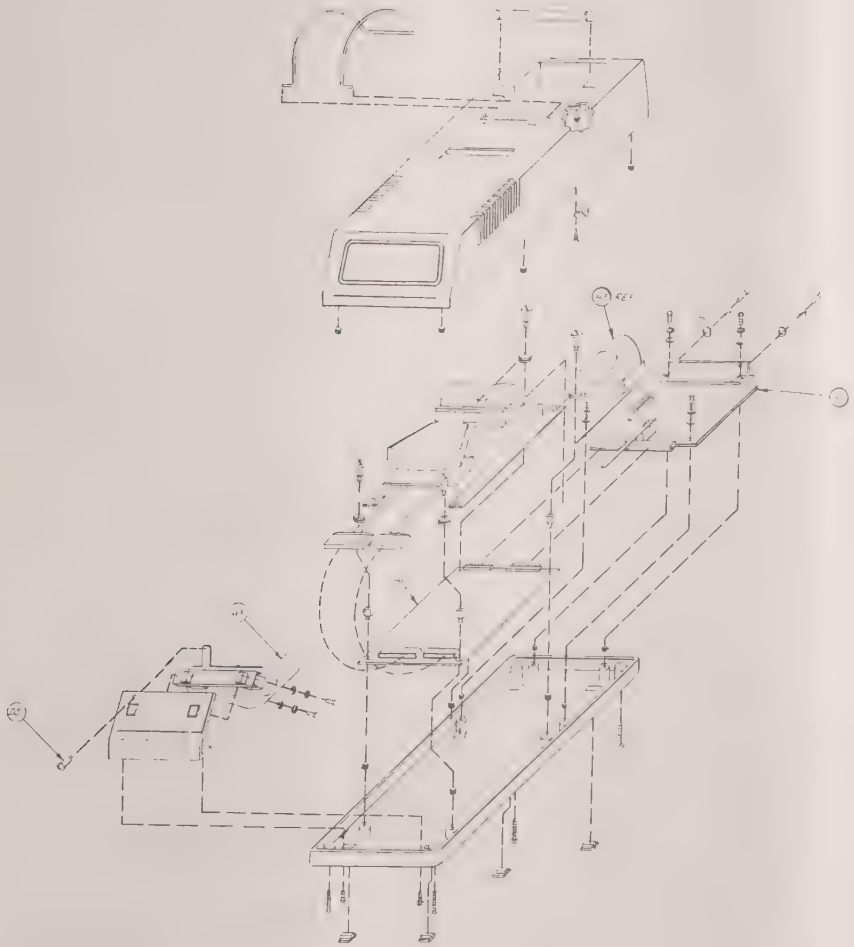


Figure 7.69. Analyzer Option 4650 Local Printer Mechanical Layout

Instruction Manual Updat

Manual Update Information

This envelope is provided for filing manual update information such as corrections to text, tables, procedures, new or revised drawings, or special application notes. Please use your own filing method to list the update entries in the blank space below.

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